N62661.AR.003610
NS NEWPORT
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FINAL SOIL FEASIBILITY STUDY DECISION UNITS 3-1, 3-2 AND 3-3 (DU 3-1, 3-2, 3-3) AT SITE 11 TANK FARM 3 OPERABLE UNIT 15 (OU 15) NS NEWPORT RI

09/26/2016

RESOLUTION CONSULTANTS

SOIL FEASIBILITY STUDY
DECISION UNITS (DU) 3-1, 3-2 AND 3-3 AT SITE 11 – TANK FARM 3 (OPERABLE UNIT 15)
Naval Station Newport
Portsmouth, Rhode Island

FINAL
Version: 1

Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Mid-Atlantic
9742 Maryland Ave.
Norfolk, VA 23511-3095

Comprehensive Long-Term Environmental Action Navy
Contract Number N62470-11-D-8013

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Prepared by:

Resolution Consultants
A Joint Venture of AECOM & EnSafe
1500 Wells Fargo Building
440 Monticello Avenue
Norfolk, VA 23510

September 26, 2016

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List of Acronyms and Abbreviations

AOC	Area of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Chemical of concern
COPC	Chemical of potential concern
DEC	Direct Exposure Criteria
DESC	Defense Energy Support Center
DGA	Data Gaps Assessment
DLA	Defense Logistics Agency
DoD	Department of Defense
DU	Decision Unit
ECH	Electrical Control House
EEQ	Ecological Effects Quotient
ERA	ecological risk assessment
ExTPH	Extractable total petroleum hydrocarbons
FEMA	Federal Emergency Management Act
FFA	Federal Facilities Agreement
FS	Feasibility Study
GRO	gasoline-range organics
HHRA	Human Health Risk Assessment
HI	Hazard Index
I/C	Industrial/Commercial
LOAELs	Lowest observed adverse effects level
LUCs	land use controls
mg/kg	milligram/kilogram
MIDLANT	Mid-Atlantic
MLW	Mean Low Water
NAVFAC	Naval Facilities Engineering Command
NAVSTA	Naval Station
Navy	Department of the Navy
NCP	National Contingency Plan
NETC	Naval Education and Training Center
NOAELS	No observed adverse effects level

NPL	National Priorities List
NUWC	Naval Undersea Warfare Center
O&M	operation and maintenance
OWS	Oil-water separator
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PQLs	practical quantitation limits
PRGs	Preliminary Remediation Goals
PSLs	Project screening levels
RAOs	Remedial Action Objectives
RBCs	Risk-based Concentrations
RD	Remedial Design
RDEC	Residential Direct Exposure Criteria
RI	Remedial Investigation
RIDEM	Rhode Island Department of Environmental Management
ROD	Record of Decision
RSLs	Regional screening levels
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SIRAR	Site Investigation and Remedial Action Report
SVOCs	Semivolatile Organic Compounds
TAL	Target analyte list
TBCs	To Be Considered
TEQ	Toxicity equivalent
TPH	Total petroleum hydrocarbons
TRVs	Toxicity reference values
TSDF	Treatment, Storage, and Disposal Facility
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UU/UE	Unlimited use/unrestricted exposure
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

This Feasibility Study (FS) report presents the development and evaluation of soil remedial alternatives for Decision Units (DU) 3-1, 3-2, and 3-3 at Site 11 – Tank Farm 3, Operable Unit 15 (the Site), located within the Naval Station (NAVSTA) Newport, in Portsmouth, Rhode Island. These three DUs represent three exposure areas within Tank Farm 3 where Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) releases have occurred. This FS addresses those releases that have impacted soil at DU 3-1 (AOC-001); DU 3-2 (AOC-020); and DU 3-3 (Electrical Control House (ECH) [Building 227] Area).

As part of the CERCLA process, a Data Gaps Assessment (DGA) was completed for soil associated with each of the three DUs, plus sediment in the adjacent brook wetlands associated with DU 3-1, and groundwater associated with DU 3-1, 3-2, and 3-3, which were identified as areas within the Site that contain known or potential CERCLA releases and require assessment under the CERCLA process (Tetra Tech, 2015). With respect to soil, the DGA Report concluded that there is an unacceptable human health risk to hypothetical child and adult residents from exposure to soil at DU 3-1, 3-2, and 3-3 (these areas were evaluated collectively in the human health risk assessment at USEPA request). The DGA Report also identified unacceptable ecological risks from polychlorinated biphenyls (PCBs) (Aroclor-1260) in soil at DU 3-3.

Groundwater and sediment sampling was also performed as part of the DGA investigation and the analytical results identified potential contamination. However, the Navy plans to conduct further characterization of the potential sediment impacts associated with DU 3-1 as part of forthcoming investigations of Tank Farm 3, as described in the following paragraphs. Once that work is completed, the Navy will incorporate sediment associated with DU 3-1 into a site-wide FS, if needed. With respect to groundwater underlying these three DUs, the Navy is deferring any future investigations and/or response actions for groundwater, to be addressed as-needed on a site-wide basis.

In parallel with completing this FS, there is team agreement to conduct a Study Area Screening Evaluation (SASE) for tank farm wide groundwater, as well as a separate SASE for remaining soil associated with the former Valve House (Building 228) and the Stripper Valve Pit (Chamber 229). The soil SASE may also encompass other potential areas formerly used by the Defense Logistics Agency (DLA), the Navy's former fuel supplier, as necessary. As part of the groundwater and soil SASE investigations, the Navy will also consider the analysis of perfluorocarbons (PFCs), an emerging contaminant, as necessary.

The Navy anticipates that after completing the soil and groundwater SASE programs, a tank farm wide RI/FS may be necessary to complete the tank farm CERCLA process. The tank farm wide FS,

along with this Soil FS (for DU 3-1, 3-2, and 3-3) will be followed with a tank farm wide Proposed Plan and Record of Decision (ROD).

This document was completed by Resolution Consultants (Resolution) for the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division (MIDLANT).

<u>Site Description</u>

Tank Farm 3 is an approximately 40-acre former fuel storage and distribution area that is located in the northern portion of the NAVSTA Newport facility. The DU 3-1 is located in the northern portion of Tank Farm 3, DU 3-2 is located in the western portion of Tank Farm 3, and DU 3-3 is located in the central portion of Tank Farm 3.

Tank Farm 3 contains five 1.18-million gallon capacity concrete USTs (Tanks 32 to 36), two 2.1-million gallon capacity steel USTs (Tanks 69 and 70), associated support utilities, roadways, and piping systems (Figure 2). The USTs were used to store aviation fuels [jet propulsion (JP)-4, JP-5, and JP-8] and marine diesel fuel. The site was used by the Navy as a fuel storage area and distribution facility from 1940 until it was leased to the Defense Logistics Agency (DLA) Energy in 1974. DLA Energy continued to use the site as a fuel storage area and distribution facility until operations were terminated in 1998.

Tank Farm 3 is currently used by Department of Defense (DoD) personnel for deer hunting during portions of the year. The property is enclosed along the perimeter with a security fence that restricts public access. The Navy has no plans to transfer the property and future use of Tank Farm 3 is expected to be limited to industrial and restricted recreational uses. It should be noted that residential development is not included in the Navy's current development plans.

Within DU 3-1, a former sand filter/burning chamber processed petroleum bottom sediment and water from USTs. The sand filter would become clogged with petroleum and would be periodically burned. As part of the petroleum remediation efforts for this site, DLA implemented an action that consisted of uncovering the sand filter, removing soil from inside the sand filter pit, pressure washing the walls and floor of the concrete pit, and backfilling the pit with fill material. However, the structure itself remains in the subsurface. DU 3-1 was investigated as part of the DGA due to the potential presence of suspected by-products of burning, including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), metals, and dioxins/furans.

Within DU 3-2, two small-pad mounted transformers are currently present. Historically, an Electrical Transformer Blockhouse existed at the same locations and was demolished around 1986. DU 3-2 was investigated as part of the DGA due to prior detections of PCBs in the area of the pad-mounted transformers. PAH and VOC analyses had been added at two locations after finding pieces of oil-soaked wood and/or soil with a moth-ball like odor at depth.

Within DU 3-3, the ECH building (Building 227) reportedly contained electrical equipment, including an indoor transformer and batteries. The building remains on-site, but is not being used. DU 3-3 was investigated as part of the DGA due to the potential for PCB and metals contamination associated with the former building use. Soil samples were collected around the outside of the building.

Regulatory Context

This Soil FS report has been prepared under the framework of CERCLA, per the Federal Facility Agreement (FFA) established for the NAVSTA Newport facility. The remedial investigation (RI) phase of CERCLA was completed with a DGA Report (Tetra Tech, 2015). During the DGA, soil, sediment, and groundwater samples were collected. With respect to soil, the DGA Report determined that there is unacceptable predicted human health risk above the USEPA target risk range for surface soil and all soil (all three DUs evaluated as one exposure area at USEPA request) under a potential future residential use of the Site and a potential ecological risk to mammals and birds at DU 3-3 only. The DGA Report recommended proceeding to a FS to evaluate remedial alternatives for the soil. As discussed above, the DGA also identified potential contamination in sediment and groundwater; however, this FS addresses only soil.

Remedial Action Objectives, Preliminary Remediation Goals, and Estimation of Areas and Volumes

The following Remedial Action Objectives (RAOs) were defined in this FS for soil based on the protection of human health and the environment.

- Prevent exposure by future residents to soil containing site contaminants that exceed residential use scenario Preliminary Remediation Goals (PRGs) at DU 3-1, 3-2, and 3-3.
- Prevent exposure by industrial and restricted recreational users to soil containing site contaminants that exceed industrial use scenario PRGs at DU 3-1, 3-2 and 3-3.
- Prevent future migration by soil contaminants to groundwater (soil COCs above Rhode Island Department of Environmental Management [RIDEM] GA Leachability Criteria) at DU 3-2 and 3-3.
- Prevent exposure by mammals and birds to surface soil containing COCs that exceed ecological PRGs at DU 3-3.

To achieve these RAOs, numeric cleanup goals called PRGs were developed for each exposure area based on an evaluation of risk-based PRGs, background concentrations, practical quantitation limits (PQLs), and other site-specific considerations (e.g., applicable or relevant and appropriate requirements [ARARs]). These PRGs are summarized in the inset table.

Preliminary Remedial Goals for Soil

Soil Parameter	Surface Soil		Subsurface Soil		DU Applicability		
	PRG (mg/kg)	Regulatory Basis	PRG (mg/kg)	Regulatory Basis	DU 3-1	DU 3-2	DU 3-3
Human Health - Residential Use Scenario [1]							
Benzo(a)anthracene	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
Benzo(a)pyrene	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	X	X	
Benzo(b)fluoranthene	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
Chrysene	0.4	RDEC	0.4	RDEC		X	
Dibenz(a,h)anthracene	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	X	X	
Indeno(1,2,3-cd)pyrene	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
Naphthalene	0.8	Leachability	0.8	Leachability	X	X	
2,3,7,8-TCDD Equivalents	0.0000048	ILCR = 10^{-6}	0.0000048	ILCR = 10^{-6}	X		
PCBs	1	TSCA	1	TSCA		X	X
Arsenic	17	Background	7	RDEC	X		X
Chromium VI[2]	0.31	ILCR = 10^{-6}	0.31	ILCR = 10^{-6}	X		X
Lead	150	RDEC	150	RDEC			X
Manganese	390	RDEC	460	Background	X		X
Human Health - Industrial Use Scenario							
Benzo(a)pyrene	0.8	I/C DEC	0.8	I/C DEC		X	
Naphthalene	0.8	Leachability	0.8	Leachability		X	
PCBs	10	I/C DEC, Leachability	10	I/C DEC, Leachability			X
Arsenic	17	Background	7	I/C DEC	X		
Ecological							
PCBs	3.6	Ecological[3]	3.6	Ecological[3]			X

Notes:

1. Residential Use Scenario PRGs are reflected for establishing a land use control boundary.
2. Chromium speciation has not been performed for this site. At this time, chromium has been assumed to be hexavalent chromium even though there is no current evidence that it would be this species. Future sampling/analysis is anticipated to show that most of the chromium detected is trivalent chromium. Upon confirmation of this assumption, hexavalent chromium would no longer be a COC at this site.
3. The basis of the Ecological PRG is the Geometric mean of NOAEL and LOAEL-based PRGs for the shrew.

ILCR = 10^{-6} – Carcinogenic risk-based goal developed from the human health risk assessment

RDEC – Residential Direct Exposure Criteria (RIDEM)

I/C DEC – Industrial/Commercial Direct Exposure Criteria (RIDEM)

Leachability – GA Leachability Criteria (RIDEM)

TSCA – Toxic Substances Control Act; Section 761.61(c) of TSCA (see Appendix B for full citation) allows for risk-based cleanup of PCB remediation waste. EPA guidance on Remedial Actions for Superfund Sites with PCB Contamination (OSWER Directive #9355.4-01FS; EPA/540/G-90/007; August 1990) was utilized to develop the risk-based value presented. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.

Background – If RIDEM criteria or risk-based PRGs were below reference concentrations for the site, the background concentration was selected

mg/kg – Milligrams per kilogram

Based on the available data and applying these PRGs, estimated quantities of contaminated soil can be quantified. The following discussion presents the basis for defining the areas and volumes of contaminated soil to be addressed in this FS.

<u>DU 3-1</u>

At DU 3-1, soil concentrations were compared to the Industrial and Residential PRGs. The following text discusses the impacted area for each land use scenario (industrial and residential). Note that there are no Ecological PRGs for DU 3-1, since the DGA Report concluded that there were no unacceptable risks to ecological receptors at DU 3-1.

- Residential PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 4,280 square feet or 0.1 acres is estimated, based on the data collected in the DGA report. The impacted volume of soil is estimated to be approximately 793 cubic yards based on an assumed average 5 foot depth of impact (current data shows impacts from the ground surface to 1 to 8 feet below the ground surface [bgs]). This volume encompasses the soil that exceeds Residential PRGs.
- Industrial PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 150 square feet is estimated, based on the data collected in the DGA report. The impacted volume of soil is estimated to be approximately 28 cubic yards based on an assumed average 5 foot depth of impact (2 to 7 feet bgs based on current data showing impacts from 4 to 6 feet bgs). This volume encompasses the subsurface soil that exceeds Industrial PRGs.

A PRG has not been developed for TPH since it is not a CERCLA-regulated contaminant; however, it is noted that residual TPH concentrations in subsurface soil in the vicinity of the former sand filter/burn pit within DU 3-1 exceed the RIDEM Residential and Industrial DECs and GA Leachability Criterion. While the remedial alternatives (other than No Action) described in this FS are expected to also address the Residential DEC for TPH through land use controls (LUCs), as described below, the Industrial DEC and GA Leachability Criterion would not be addressed. Rather, the Navy will address the residual TPH separately from the CERCLA cleanup under the RIDEM UST and Remediation regulations.

DU 3-2

At DU 3-2, soil concentrations were compared to the Industrial and Residential PRGs. The following text discusses the impacted area for each land use scenario (industrial and residential). Although PRG exceedances were not observed at TF3-020-SB102B, remedial actions are recommended to address the oil-soaked wood. Note that there are no Ecological PRGs for DU 3-2, since the DGA Report concluded that there were no unacceptable risks to ecological receptors at DU 3-2.

- Residential PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 415 square feet is estimated, based on the data collected and oil-soaked wood observed in the DGA report. The impacted volume of soil is estimated to be approximately 77 cubic yards based on an assumed average 5 foot depth of impact (current data shows impacts from the ground surface to 1 to 4 feet bgs). This volume encompasses the soil that exceeds Residential PRGs (including the RIDEM GA Leachability Criterion for naphthalene).
- Industrial PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 175 square feet is estimated, based on the data collected and oil-soaked wood observed in the DGA report. The impacted volume of soil is estimated to be approximately 32 cubic yards based on an assumed average 5 foot depth of impact (current data shows impacts from 2 to 4 feet bgs). This volume encompasses the soil that exceeds Industrial PRGs (including the RIDEM GA Leachability Criterion for naphthalene).

DU 3-3

At DU 3-3, soil concentrations were compared to the Industrial, Residential, and Ecological PRGs. The following text discusses the impacted area for each land use scenario (industrial and residential).

- Residential PRGs: For the purpose of evaluating remedial alternatives, an impacted area approximately 2,070 square feet is estimated, based on the data collected in the DGA report. Assuming an average depth of 2 feet (current data shows impacts mainly in top 1 foot), the impacted volume of soil is estimated to be approximately 153 cubic yards. This area encompasses the soil that exceeds Residential PRGs (including the RIDEM GA Leachability Criterion for PCBs).
- Industrial PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 150 square feet is estimated, based on the data collected in the DGA report. The impacted volume of soil is estimated to be approximately 28 cubic yards based on an assumed 5 foot depth of impact (current data shows impacts from the ground surface to 4 feet bgs). This volume encompasses the soil that exceeds Industrial PRGs (including the RIDEM GA Leachability Criterion for PCBs).
- Ecological PRGs: For the purpose of evaluating remedial alternatives, the estimated area and volume of soils that exceeds the Ecological PRG, based on the data collected in the DGA report, is the same as that identified above for Industrial PRGs.

A PRG has not been developed for TPH since it is not a CERCLA-regulated contaminant; however, one surface soil sample collected within DU 3-3 during the DGA contained TPH at a concentration slightly above the Residential DEC and GA Leachability Criterion. The TPH exceedance is co-located with the most elevated concentration of PCBs and it is expected that the remedial alternatives (other than No Action) described in this FS will also address the co-located TPH to below RIDEM criteria.

<u>Remedial Alternatives</u>

As part of the FS, five alternatives were developed and screened for soil at DU 3-1, 3-2, and 3-3. An alternative was developed for soil at DU 3-1, 3-2, and 3-3 that would remove all accessible soil exceeding Residential, Industrial, and Ecological PRGs and would require land use controls (LUCs) to maintain the ECH building foundation at DU 3-3, since the underlying soil has not been assessed. However, the alternative has a limited benefit (small area that would be made available for UU/UE) as compared to the cost of remediation as well as the anticipated future land use (i.e., industrial). Additionally, a treatment (in-situ thermal desorption) alternative with LUCs was developed for soil at DU 3-1, 3-2, and 3-3. However, the alternative was also screened out due to the high costs and limited benefit as compared to the cost of remediation. As such, these two alternatives were not retained for detailed analysis. Per the stepwise CERCLA process for the development of remedial alternatives, the following three alternatives were defined, retained, and evaluated in detail in the Soil FS for DU 3-1, 3-2, and 3-3.

- Alternative S-1 – No Action
  - No action
- Alternative S-2 – Limited Soil Excavation with Land Use Controls
  - Limited soil excavation and off-site disposal at DU 3-2 and DU 3-3 to meet Industrial PRGs (includes removal of all soils exceeding RIDEM GA Leachability Criteria) and also at DU 3-3 to meet Ecological PRGs.
  - LUCs at DU 3-1, 3-2, and 3-3 to prevent future residential use. LUCs would also be required at DU 3-1 to prevent direct exposure to subsurface soil exceeding the industrial PRG for arsenic. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet Toxic Substances Control Act (TSCA) protectiveness standards so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy.
- Alternative S-3 – Containment with Land Use Controls
  - Installation of an asphalt cover system (asphalt pavement over sub-base material) at DU 3-2 and 3-3 to prevent direct contact, erosion, and transport of remaining soil exceeding Industrial PRGs (including soils exceeding RIDEM GA Leachability Criteria) and Ecological PRGs. The asphalt cover system would also minimize future leaching of soil contaminants to groundwater.
  - LUCs at DU 3-1, 3-2, and 3-3 to prevent future residential use. LUCs at DU 3-1 to prevent direct contact with subsurface soil exceeding the Industrial PRG for arsenic. LUCs at DU 3-2 and 3-3 that restrict cover disturbance and require maintenance of the asphalt cover and associated inspections and reporting. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards

so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy.

Table ES-1 also presents a summary of the main components of the remedial alternatives described above. Table ES-2 presents an abbreviated summary of the detailed evaluation and comparative analysis of remedial alternatives using the seven criteria to be evaluated during the FS phase of the CERCLA process. Two additional criteria, state and community acceptance, will be evaluated as part of the subsequent regulatory and community review phase.

The next step in the CERCLA process is typically to discuss these candidate alternatives with the regulatory agencies, and then recommend one of them as a remedial alternative for public consideration and comment. However, the discussion and recommendation of a remedial alternative for soil associated with DU 3-1, DU 3-2, and DU 3-3 will be deferred until the Navy completes the RI/FS for the entire tank farm. At that time, the recommended remedial alternative will then be described in a Proposed Plan, to be distributed to the local community and presented at a public meeting to solicit input and comments prior to selecting the final remedy for the site. The final remedy will be documented in a ROD.

Table ES-1
Summary of Remedial Alternative Components

Main Components	Alternative [1]		
	S-1: No Action	S-2: Limited Soil Excavation with Land Use Controls	S-3: Containment with Land Use Controls
Additional sampling to delineate exceedances at DU 3-1, 3-2, and 3-3		X	X
Soil excavation at DU 3-2 and 3-3 to remove soil exceeding the Industrial PRGs (including RIDEM GA Leachability Criteria) and Ecological PRG (applicable to DU 3-3 only)		X	
Installation of an asphalt cover system at DU 3-2 and 3-3			X
LUCs applied to DU 3-1, 3-2, and 3-3 preventing residential use.		X	X
LUCs would also be established to assure that at least two feet of surface soil (0-2 feet) remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG.		X	X
LUCs at DU 3-3 to require maintenance of the ECH building foundation and prevent access to underlying soil		X	X
LUCs that restrict cover disturbance and require maintenance of the asphalt covers as well as perform associated inspections, and reporting			X

<u>Notes</u>:

1. Only the remedial alternatives retained for detailed analysis are presented here.

LUCs – Land use controls

PRGs – Preliminary Remediation Goals

Table ES-2
Summary of Detailed Evaluation and Comparative Analysis

Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long Term Effectiveness and Permanence	Reduction of TMV through Treatment	Short-Term Effectiveness	Implementability	Cost [1]
S-1: No Action	Alternative S-1 would not be protective of human health and the environment because contact with contaminated soil would not be prevented. Additionally, Alternative S-1 would not be protective of groundwater at DU 3-2 and DU 3-3, because it does not address RIDEM GA Leachability Criteria exceedances in soil.	Does not comply with ARARs	Alternative S-1 is not effective and doesn't provide permanent protection from contaminants.	This alternative does not include/involve treatment.	Since no construction activities or remedial actions are proposed under Alternative S-1, there are no additional short-term risks to the community, workers, and environment.	Alternative S-1 is considered the most implementable since no construction activities or remedial actions are proposed.	Total Cost: $0
S-2: Limited Soil Excavation with Land Use Controls	Alternative S-2 removes all soil that exceeds the Industrial PRGs (including RIDEM GA Leachability Criteria) at DU 3-2 and 3-3 and the Ecological PRG at DU 3-3. Alternatives S-2 requires implementation of LUCs to restrict residential use at all DUs and require maintenance of the building foundation at DU 3-3, which adds protection to human health. Alternative S-2 is slightly more protective than Alternative S-3 because soils with the highest levels of contamination would be removed.	Meets ARARs	Alternative S-2 has the highest long-term effectiveness because it removes soils exceeding Industrial PRGs at DU 3-2 and 3-3 and does not rely on long-term maintenance of an asphalt cover system. However, both Alternatives S-2 and S-3 rely on LUCs at DU 3-3 to require maintenance of the building foundation. This alternative utilizes controls to prevent exposure to contaminated soil over the long-term to provide the desired long-term effectiveness.	This alternative does not include/involve treatment.	Alternatives S-2 and S-3 have similar short-term impact to natural habitats since they have the longest construction period and impact the same construction footprint. Given the small size of DU 3-1, 3-2, and 3-3, short-term risks are not considered significant under any of the remedial alternatives discussed in this FS.	Alternative S-2 is relatively easy to implement. LUCs and excavation are proven technologies.	Capital Cost: $368,759 O&M: $92,461 Five-Year Reviews: $23,307 Total Cost: $485,000
S-3: Containment with Land Use Controls	Alternative S-3 installs an asphalt cover over soil in excess of the Industrial PRGs (including RIDEM GA Leachability Criteria) at DU 3-2 and 3-3. Alternative S-3 is slightly less protective than Alternative S-2 since soil exceeding the Industrial PRGs remains in place. Although contaminated soil remains in place, the asphalt covers would prevent direct contact, erosion, and transport of remaining surface soil exceeding residential PRGs and would minimize future leaching of soil contaminants to groundwater.	Meets ARARs	Alternative S-3 is less effective than Alternative S-2 since contaminated soil exceeding the Industrial PRGs remains in place. However, this alternative utilizes controls to prevent exposure to contaminated soil over the long-term to provide the desired long-term effectiveness. Additionally, the alternative installs a physical barrier over contaminated soil and requires maintenance of the DU 3-3 building foundation.	This alternative does not include/involve treatment.	Alternatives S-2 and S-3 have similar short-term impact to natural habitats since they have the longest construction period and impact the same construction footprint. Given the small size of DU 3-1, 3-2, and 3-3, short-term risks are not considered significant under any of the remedial alternatives discussed in this FS.	Alternative S-3 is the most difficult to implement because of the administrative burden of future inspections and maintenance over the long-term. LUCs and cover systems are proven technologies. Alternative S-3 is slightly more difficult to implement than Alternative S-2.	Capital Cost: $369,709 O&M: $105,670 Five-Year Reviews: $23,307 Total Cost: $499,000

Notes:
LUCs – Land use controls
ARAR – Applicable or relevant and appropriate requirement
O&M – Operation and maintenance
PRGs – Preliminary Remediation Goals

1.0 PROJECT BACKGROUND

This Feasibility Study (FS) report presents the development and evaluation of soil remedial alternatives for Decision Units (DU) 3-1, 3-2, and 3-3 at Site 11 – Tank Farm 3, Operable Unit 15 (the Site), located within the Naval Station (NAVSTA) Newport, in Portsmouth, Rhode Island. These three DUs represent three exposure areas within Tank Farm 3 where Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) releases have occurred. This FS addresses those releases that have impacted soil at DU 3-1 (AOC-001); DU 3-2 (AOC-020); and DU 3-3 (Electrical Control House (ECH) [Building 227] Area).

As part of the CERCLA process, a Data Gaps Assessment (DGA) was completed for soil associated with each of the three DUs, plus sediment in the adjacent brook wetlands associated with DU 3-1, and groundwater associated with DU 3-1, 3-2, and 3-3, which were identified as areas within the Site that contain known or potential CERCLA releases and require assessment under the CERCLA process (Tetra Tech, 2015). With respect to soil, the DGA Report concluded that there is an unacceptable human health risk to hypothetical child and adult residents from exposure to soil at DU 3-1, 3-2, and 3-3 (these areas were evaluated collectively in the human health risk assessment at USEPA request). The DGA Report also identified unacceptable ecological risks from polychlorinated biphenyls (PCBs) (Aroclor-1260) in soil at DU 3-3.

Groundwater and sediment sampling was also performed as part of the DGA investigation and the analytical results identified potential contamination. However, the Navy plans to conduct further characterization of the potential sediment impacts associated with DU 3-1 as part of forthcoming investigations of Tank Farm 3, as described in the following paragraphs. Once that work is completed, the Navy will incorporate sediment associated with DU 3-1 into a site-wide FS, if needed. With respect to groundwater underlying these three DUs, the Navy is deferring any future investigations and/or response actions for groundwater, to be addressed as-needed on a site-wide basis.

In parallel with completing this FS, there is team agreement to conduct a Study Area Screening Evaluation (SASE) for tank farm wide groundwater, as well as a separate SASE for remaining soil associated with the former Valve House (Building 228) and the Stripper Valve Pit (Chamber 229). The soil SASE may also encompass other potential areas formerly used by the Defense Logistics Agency (DLA), the Navy's former fuel supplier, as necessary. As part of the groundwater and soil SASE investigations, the Navy will also consider the analysis of perfluorocarbons (PFCs), an emerging contaminant, as necessary.

The Navy anticipates that after completing the soil and groundwater SASE programs, a tank farm wide RI/FS may be necessary to complete the tank farm CERCLA process. The tank farm wide FS, along with this Soil FS (for DU 3-1, 3-2, and 3-3) will be followed with a tank farm wide Proposed Plan and Record of Decision (ROD).

This document was completed by Resolution Consultants (Resolution) for the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division (MIDLANT).

1.1 Purpose and Approach

Together with the prior investigations at Tank Farm 3, as documented in the 2006 Site Investigation and Remedial Action Report (SIRAR), the DGA satisfies the requirements of a Remedial Investigation (RI) for Tank Farm 3. The DGA report contains a comprehensive summary of historical activities and investigations at the Site, along with the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA. The DGA Report evaluates and presents findings for DU 3-1, 3-2, and 3-3 at Site 11 – Tank Farm 3.

This FS was completed according to the United States Environmental Protection Agency (USEPA) FS guidelines. Each remedial alternative was evaluated according to the following National Contingency Plan (NCP) criteria.

- Overall Protection of Human Health and Environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long-term Effectiveness and Permanence
- Reduction in toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Two additional criteria, state acceptance and community acceptance, will be evaluated as part of the regulatory and community review phase of the CERCLA process, as the Proposed Plan is prepared with the regulatory agencies and reviewed by the community.

1.2 Naval Station Newport Background Information

NAVSTA Newport is a 1,000-acre Navy facility that is located on Aquidneck Island in Rhode Island and spans across the City of Newport and the Towns of Middletown, Portsmouth, and Jamestown

(Figure 1). The facility has been used by the Navy since as early as the Civil War. During World Wars I and II, military activities at the facility increased significantly and housing was provided for many servicemen. In subsequent peacetime years, use of onsite facilities was slowly phased out until 1962, when Newport became the headquarters for the Commander Cruiser-Destroyer Force Atlantic. In April of 1973, the Shore Establishment Realignment Program reorganized naval forces which led to decreased military activity at the facility and resulted in the Navy excessing 1,629 acres of property.

Since 1974, research and development and training have been the primary activities at NAVSTA Newport. The facility was renamed from Naval Education and Training Center (NETC) to NAVSTA Newport in 1998. The major commands located at the NAVSTA facility include the NETC, the Surface Warfare Officers School Command, the Naval Undersea Warfare Center (NUWC), the Naval War College, and others.

In November 1989, NAVSTA Newport (NETC at the time) was added to the National Priorities List (NPL). A Federal Facilities Agreement (FFA) was developed and signed by the Navy, the State of Rhode Island, and USEPA in March of 1992 to outline the response action requirements under the CERCLA regulatory framework at NAVSTA Newport. The FFA was developed, in part, to ensure that the environmental impacts associated with past CERCLA releases at NAVSTA Newport are properly investigated and remediated if needed.

1.3 Tank Farm 3 Background Information

Site 11 – Tank Farm 3 is an approximately 40-acre area that is located in NAVSTA Newport within close proximity to Narragansett Bay (Figure 1). Tank Farm 3 is located in the Melville section of Portsmouth, Rhode Island. DU 3-1 is located in the northern portion of Tank Farm 3. DU 3-2 is located in the western portion of Tank Farm 3. DU 3-3 is located in the central portion of Tank Farm 3 (Figure 2).

Tank Farm 3 contains five 1.18-million gallon capacity concrete USTs (Tanks 32 to 36), two 2.1-million gallon capacity steel USTs (Tanks 69 and 70), associated support utilities, roadways, and piping systems (Figure 2). The USTs stored aviation fuels [jet propulsion (JP)-4, JP-5, and JP-8] and marine diesel fuel. Tank Farm 3 was used by the Navy as a fuel storage area and distribution facility from 1940 until it was leased to the Defense Energy Support Center (DESC) in 1974. DESC continued to use the site as a fuel storage area and distribution facility until operations were terminated. Tank closure activities and associated remediation of soil and groundwater were performed at Tank Farm 3 between 1996 and 2005; however, Rhode Island Department of Environmental Management (RIDEM) has not issued closure certificates for the tanks and fuel lines.

Most of the fuel lines were closed in 1996. Additionally, fuel lines along Defense Highway were closed in 1998. The tank closure investigations, and/or response actions are being completed under state UST regulations.

Tank Farm 3 is also used by Department of Defense (DoD) personnel for deer hunting during portions of the year. The property is enclosed along the perimeter with a security fence that restricts public access. The Navy has no plans to transfer the property and future use of Tank Farm 3 is expected to be limited to industrial and restricted recreational use. It should be noted that residential development is not included in the Navy's current development plans.

1.3.1 Site Description

Site 11 – Tank Farm 3 is bordered by the Navy's Defense Highway (Burma Road) to the northwest, Raytheon's Submarine Signal Division plant property to the northeast, and residential property to the southeast and southwest (Figure 2). Tank Farm 4 is located 700 feet south of the Site and the Narragansett Bay is located approximately 200 feet northwest of the Site (Figure 1). Additionally, the Lawton Valley Reservoir, which is a drinking water supply for Newport, Middletown, and Portsmouth, is located 2,000 feet southeast (upgradient) of the Site. DU 3-1 is located in the northern portion of Site 11 – Tank Farm 3, between Defense Highway and Tank 32. DU 3-2 is located in the western portion of Site 11 – Tank Farm 3, south of Tank 34. DU 3-3 is located in the central portion of Site 11 – Tank Farm 3, north of Tank 36 and northwest of Tank 69.

Most of Site 11 – Tank Farm 3 is covered in vegetation, such as brush and grasses, with some cleared areas for access roads. In the northeastern portion of Site 11 – Tank Farm 3, Lawton Brook and a wetlands area are present. Additionally, Site 11 – Tank Farm 3 contains a small patch of hardwood forest. Public access to the site is restricted by a security fence along the perimeter of the property. The Navy has no plans to transfer the property and access restrictions are not anticipated to change.

Topography at Site 11 – Tank Farm 3 slopes downward from 100 feet above mean low water (MLW) in the south central portion of the Site to 40 feet above MLW on the northwestern side of the site and 10 feet above MLW along Lawton Brook (Tetra Tech, 2015).

1.3.2 Site History

The Navy has owned the Site 11 – Tank Farm 3 property since the 1940s. Tanks 32 to 36 were installed in the early 1940s while Tanks 69 and 70 were installed in 1953 and 1954, respectively.

The Former Sand Filter/Burn Pit, within DU 3-1, is shown on aerial photographs from 1954 and 1975. Prior to 1974, tank bottoms were periodically pumped to a sand filter that was located within

DU 3-1. The filtered water was discharged into the Bay, while the remaining residual oil was reportedly burned at the sand filter or disposed of at an off-site location. Additionally, the Former Sand Filter/Burn Pit was reportedly used to filter groundwater from the UST ring drains. Operations ceased at the Former Sand Filter/Burn Pit in 1974. Since then, the sediment and water from tank bottoms has been disposed of off-site and an oil-water separator (OWS) has been used to process groundwater collected from ring drains. The OWS outfall is regulated by a Rhode Island Pollutant Discharge Elimination System permit.

Aerial photographs from 1951 through 1979 show the Electrical Transformer Blockhouse at the location of DU 3-2. Aerial photographs indicate that the Electrical Transformer Blockhouse was demolished around 1986. Two small pad-mounted transformers, which replaced the Electrical Transformer Blockhouse, are shown on aerial photographs from 1988 and 1995.

The ECH within DU 3-3 is shown on aerial photographs from 1954. Ground disturbance around the area suggests that it was new construction. The ECH building reportedly contained electrical equipment, including an indoor transformer (that may have contained PCB-containing oil) and batteries (Tetra Tech, 2015). During an October 2015 site visit, no floor drains or cracks were observed in the concrete floor. Electrical equipment remains, but it is not known if PCB-containing oils are present.

1.3.3 Previous Investigations

As discussed in Section 1.0, this FS focuses exclusively on DU 3-1, 3-2, and 3-3 and the chemicals of concern (COCs) in soil requiring the consideration of a CERCLA response action. Previous investigations as they relate specifically to DU 3-1, 3-2, and 3-3 at Tank Farm 3 include the Site Investigation and Remedial Action Report (SIRAR) for Tank Farm 3 (Tetra Tech EC, 2006) and Data Gaps Assessment (DGA) Report for AOCs-001, 020, and the ECH Area Within Site 11 (Tank Farm 3) (Tetra Tech, 2015).

Site Investigation and Remedial Action Report (Tetra Tech EC, 2006)

A Draft SIRAR was published in 2006 by Tetra Tech EC, Inc. (TtEC). The objective of the report was to present a summary of the work performed from May 2004 through April 2005 and to identify and remediate AOCs related to DESC operation of the facility under RIDEM regulations. The SIRAR investigated 31 AOCs identified by Stereographic Aerial Photography Analysis from 1942 through 1995 (including but not limited to AOC-001 and AOC-020), tank walls, tank vents, oil/water separator #3, swales, and the former Valve House (Building 228), transformer locations, and groundwater.

DU 3-1: As part of the SIRAR, the sand filter pit was exposed and visibly contaminated oily material was observed from inside the sand filter pit. The soil was then excavated and stockpiled for disposal. The walls and floor of the sand filter pit were pressure washed and the rinsate water was removed for disposal. At the direction of RIDEM, test pitting was also performed adjacent to the sand filter pit. A total of 29 soil samples were collected at DU 3-1. Samples were analyzed for TPH (including diesel range organics [DRO] and gasoline range organics [GRO]). At samples TF3-001-S1-2.0 and TF3-001-S3-2.5, TPH concentrations exceeded the current RIDEM Industrial/Commercial direct exposure criteria (I/C DEC) of 2,500 mg/kg and GA leachability criteria of 500 mg/kg. Additional soil samples were collected to delineate contamination. However, due to the instability of the area, the area surrounding sample TF3-001-S1-2.0 was not remediated. As discussed further in Section 2.0, TPH is not CERCLA contaminant and the Navy will address the residual TPH separately from the CERCLA cleanup under the RIDEM UST and Remediation regulations.

DU 3-2: Also, as part of the SIRAR, PCB sampling was performed around the base of the two electrical transformers. A total of eight soil samples were collected from DU 3-2; one surface soil sample (0-1 ft bgs) was collected from the center of each side of the concrete pads. The maximum PCB concentration detected was 8.2 mg/kg, which is below the RIDEM residential direct exposure criteria (RDEC) and I/C DEC. No remedial actions were completed for this area.

<u>2013 Data Gaps Assessment Report (Tetra Tech, 2015)</u>

As part of the 2013 DGA, field investigation of DU 3-1, 3-2, and 3-3 at Site 11 – Tank Farm 3 was conducted under CERCLA to refine the characterization of these areas, as well as quantify potential risks posed by CERCLA contaminants. An overview of the DGA field activities is presented below.

<u>DU 3-1 Field Activities</u>

During the 2013 DGA, surface soil and subsurface soil samples were collected in the vicinity of DU 3-1. A total of eight surface soil samples and ten subsurface soil samples were collected from nine soil borings. At location TF3-001-SB101, the upper one foot contained a boulder, so two subsurface soil samples were collected. Surface soil samples were collected from 0 to 1 foot below ground surface (bgs) and subsurface soil samples were collected from a selected interval between 1 and 8 feet bgs. All samples were analyzed for VOCs, polycyclic aromatic hydrocarbons (PAHs), dioxins, gasoline range organics (GRO), extractable TPH (ExTPH), and target analyte list (TAL) metals. Figure 3 presents the soil sample locations in the vicinity of DU 3-1. The analytical results are summarized in Section 1.3.5, Nature and Extent of Contamination.

<u>DU 3-2 Field Activities</u>

During the 2013 DGA, surface soil and subsurface soil samples were collected in the vicinity of DU 3-2. A total of ten surface soil samples and ten subsurface soil samples were collected from 11 soil borings. At one boring location (TF3-020-SB102A), a surface soil sample was collected, but then concrete was encountered, so an additional boring (TF3-020-SB102B) was advanced 10 feet to the north and a subsurface soil sample was collected from the step-out location. Surface soil samples were collected from 0 to 1 foot bgs and subsurface soil samples were collected from 2 to 4 feet bgs. All samples were submitted for laboratory analysis of PCBs. In addition, two subsurface soil samples (TF3-020-SB102B and TF3-020-SB107) were also analyzed for VOCs and PAHs after finding pieces of oil-soaked wood and/or soil with a moth-ball like odor.

Figure 4 presents the soil sample locations in the vicinity of DU 3-2. The analytical results are summarized in Section 1.3.5, Nature and Extent of Contamination.

<u>DU 3-3 Field Activities</u>

During the 2013 DGA, surface soil and subsurface soil samples were collected in the vicinity of DU 3-3. A total of ten surface soil samples and ten subsurface soil samples were collected from ten soil borings. Surface soil samples were collected from 0 to 1 foot below ground surface (bgs) and subsurface soil samples were collected from 2 to 4 feet bgs. All samples were analyzed for PCBs, TAL metals, and petroleum hydrocarbons (GRO and ExTPH). Figure 5 presents the soil sample locations in the vicinity of DU 3-3. The analytical results are summarized in Section 1.3.5, Nature and Extent of Contamination.

1.3.4 Physical Characteristics

A brief discussion of the physical characteristics of the site is provided below based on information provided in the 2013 DGA Report (Tetra Tech, 2015). Refer to the DGA Report for more detailed information.

Site 11 – Tank Farm 3 is located on the southeastern end of the Narragansett Basin over the Rhode Island formation. This is comprised mostly of non-marine sedimentary rocks from the Pennsylvanian age including conglomerate, sandstone, schist, carbonaceous schist, phyllite, and graphite. Overburden material at Site 11 – Tank Farm 3 is a glacial till comprised of silt, sand, and gravel. The till is generally between approximately 4 and 25 feet thick. In the central portion of Site 11 – Tank Farm 3, the depth to bedrock is shallow (encountered from 4 to 11 feet bgs). Bedrock has been characterized as metamorphosed shale with occasional strata of siltstone, sandstone, conglomerate, schist, phyllite, slate, and quartz (GZA, 1995; GZA, 1996).

Groundwater underlying Site 11 – Tank Farm 3 generally occurs within the bedrock or near the overburden/bedrock interface in some areas (the seasonal high water table is above the bedrock surface in 4 monitoring wells out of 23 measured) (GZA, 1995). In water level measurements from the 35 wells, performed in May 1996, the depth to groundwater (measured in feet from top of casing) varied between 9.74 and 25.8 feet (ground surface elevation not given). At the majority (19) of the wells, water depths from top of casing measured between 15 and 20 feet, ten wells measured less than 15 feet, and five wells measured between 20 and 25.8 feet (FwEC, 2002). The water table is reported to seasonally fluctuate between approximately 0.3 and 10.3 feet (GZA, 1995).

Groundwater flow at the Site generally follows surface topography, flowing to the north in the western and central portions of the site, and to the northeast in the eastern portions of the site, toward Lawton Brook. The groundwater table has a generally steep hydraulic gradient of 3 to 10 feet per 100 feet.

RIDEM has classified the groundwater beneath the site as GA, indicating that the groundwater is "presumed to be suitable for drinking water use without treatment." Groundwater is also required to meet federal drinking water standards, which are relevant to CERCLA cleanup actions at the site.

The majority of Site 11 – Tank Farm 3 is covered with overgrown vegetation and brush, paved access roads with a few clear areas, and miscellaneous support structures such as transfer pumps and control chambers. A wooded area is present between the area of Site 11 – Tank Farm 3 where the tanks are located, and Lawton Brook and associated wetlands, which are located just northeast of Site 11 – Tank Farm 3. Lawton Brook and associated wetlands fall within the Federal Emergency Management Act (FEMA) 100-year and 500-year floodplain boundaries (see Figure 2).

1.3.5 Nature and Extent of Contamination

A summary of the nature and extent of contamination at DU 3-1, 3-2, and 3-3 is presented below. As part of the 2013 DGA (Tetra Tech, 2015), soil and sediment sample results, with the exception of dioxins, were compared to the USEPA Regional Screening Levels (RSLs) for both Residential Soil and Industrial Soil. Although there is no known source of hexavalent chromium at the Site, total chromium concentrations were compared to the hexavalent chromium RSL. For dioxin analytical results, the total toxicity equivalent (TEQ) of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) was compared with Project Screening Levels (PSLs) as reported in the Sampling and Analysis Plan (SAP) (Tetra Tech, 2013). The ExTPH/GRO results are compared to the RIDEM RDEC and I/C DEC.

The following text discusses the nature and extent of contamination in relation to the DGA screening criteria.

DU 3-1

The locations of soil borings in the vicinity of DU 3-1 are shown on Figure 3. Analytical data tables containing the surface soil and subsurface soil analytical data are presented in the DGA Report (Tetra Tech, 2015).

A total of 8 surface soil samples and 10 subsurface samples were taken from 9 soil borings in the vicinity of DU 3-1. At location TF3-001-SB101, the upper one foot contained a boulder, so two subsurface soil samples were collected. Soil samples were analyzed for VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO).

Several VOCs were detected in soil samples at low concentrations below USEPA RSLs. Most VOCs are petroleum derivatives and were single detections in subsurface soil samples from TF3-001-SB101 and TF3-001-SB103 on the southeast and south sides of the former sand filter/burn pit. Petroleum-like odors were detected in the subsurface soil at TF3-001-SB103, which is in proximity to a mapped bottom and sediment water line.

Several PAHs were detected in soil across DU 3-1, with more frequent detections in surface soil samples. One PAH, benzo(a)pyrene, was detected at concentrations that exceed the USEPA RSL for residential soil in the majority of surface soil and subsurface soil samples. None of the concentrations exceed the USEPA RSL for industrial soil.

Aluminum, arsenic, cobalt, iron, and manganese concentrations in surface soil and subsurface soil samples exceeded the RSLs for residential soil. Thallium was also detected above the RSL less frequently and only in surface soil. Arsenic concentrations also exceeded the RSL for industrial soil in all samples.

As part of the DGA, metals data from the Basewide Background Study Report (Tetra Tech, 2008), was used to perform a “dataset-to-dataset” statistical comparison between the soil data at the Site and the established background concentrations of metals. The background comparison concluded that aluminum and arsenic concentrations in surface soil were consistent with background concentrations. However, cobalt, iron, and manganese were detected at concentrations greater than background concentrations in surface soil. In subsurface soil, manganese concentrations were determined to be consistent with background. However, aluminum, arsenic, cobalt, and iron concentrations in subsurface soil were greater than background.

A spatial distribution pattern of metals at elevated levels was not evident. Metals were detected above screening criteria in every sampling location.

Dioxins were detected in all surface and subsurface soil samples. The total TEQ was calculated as the sum of TEQ values for individual congeners. Surface soil concentrations ranged from 2.3 to 150 pg/g and subsurface soil concentrations ranged from 3.2 to 11.2 pg/g, with three surface soil samples and five subsurface soil samples exceeding the screening criterion of 4.2 pg/g. The screening criterion is the screening level for total TEQ of 2,3,7,8-TCDD (4.2 pg/g), divided by the congener's 2005 World Health Organization (WHO) Toxic Equivalency Factor (TEF) for humans and mammals (Van den Berg, et al, 2006).

Low levels of ExTPH contamination were detected in several samples across DU 3-1. However, TF3-001-SB103 (6 to 8 feet bgs; 2,350 mg/kg [average between sample and associated field duplicate]) was the only location where concentrations exceeded the RIDEM RDEC and GA leachability criteria of 500 mg/kg, but did not exceed the RIDEM industrial DEC of 2,500 mg/kg. This sample is located south of the former sand filter/burn pit, in proximity to a mapped bottom sediment and water line. Filter fabric was encountered during drilling. The filter fabric had been used to mark the boundary between excavated and non-excavated soil during the SIRAR field activities in 2004. Although, only one sample from the DGA exceeded RIDEM criteria for TPH, two subsurface soil samples collected during the SIRAR also exceeded RIDEM criteria for TPH. As discussed further in Section 2.0, TPH is not CERCLA contaminant and the Navy will address the residual TPH separately from the CERCLA cleanup under the RIDEM UST and Remediation regulations. Although the intent of the DGA was to revisit and sample the two SIRAR subsurface soil locations with elevated TPH, it appears that the actual DGA samples were not located sufficiently close to the historic locations. Therefore, as part of pre-design investigation, samples will be collected at these two subsurface soil locations for the following parameters: VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO). The results will be compared to the DU 3-1 PRGs and to RIDEM criteria.

DU 3-2

The locations of soil borings and groundwater wells in the vicinity of the DU 3-2 are shown on Figure 4. Analytical data tables containing the surface soil and subsurface soil analytical data are presented in the DGA Report (Tetra Tech, 2015).

During the DGA, a total of 10 surface soil samples and 10 subsurface samples were taken from 11 soil borings in the vicinity of DU 3-2. At one boring location (TF3-020-SB102A), a surface soil sample was collected but then concrete was encountered, so an additional boring (TF3-020-SB102B) was advanced 10 feet to the north and a subsurface soil sample was collected from the step-out location. All soil samples were analyzed for PCBs. In addition to PCBs, two subsurface soil samples (TF3-020-SB102B and TF3-020-SB107) were analyzed for PAHs and VOCs after finding pieces of oil-soaked wood and/or soil with a moth-ball like odor at depth. PCB surface soil results from 2004 from 8 locations were also used to define the nature and extent of contamination.

Aroclor-1254 and Aroclor-1260 were detected in surface and subsurface soil. Additionally, Aroclor-1242 was detected in surface soil only. Aroclor-1242, Aroclor-1254, and Aroclor-1260 concentrations in a subset of surface soil samples exceeded USEPA RSLs for residential soil. Additionally, Aroclor-1254 and Aroclor-1260 concentrations in a smaller subset of surface soil samples exceeded the USEPA RSLs for industrial soil. The highest PCB concentrations were identified on the east and west sides of Transformer 2 as well as the north side of Transformer 1. Subsurface soil concentrations did not exceed USEPA RSLs for residential or industrial soil.

VOC analysis was added at two subsurface soil locations in response to an observed moth-ball like odor. Only 2-butanone was detected at both TF3-020-SB-102B and TF3-020-SB107; however, concentrations were several orders of magnitude lower than the USEPA RSL for residential soil. 2-butanone is recognized by USEPA as a common laboratory contaminant and is likely not site-related.

Several PAHs were detected in subsurface soil at the two locations where oil-soaked wood was observed. Of the detected PAHs, four PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene) exceeded USEPA RSLs for residential soil and industrial soil. Additionally, indeno(1,2,3-cd)pyrene and naphthalene exceeded the USEPA RSLs for residential soil. Naphthalene concentrations also exceeded GA leachability criteria. All of the maximum concentrations were from TF3-020-SB107. It is uncertain if the wood was related to the former building at this location.

<u>DU 3-3</u>

The locations of soil borings and groundwater wells in the vicinity of DU 3-3 are shown on Figure 5. Analytical data tables containing the surface soil and subsurface soil analytical data are presented in the DGA Report (Tetra Tech, 2015).

During the DGA, a total of 10 surface soil samples and 10 subsurface samples were taken from 10 soil borings in the vicinity of DU 3-3. All soil samples were analyzed for PCBs, metals, and petroleum hydrocarbons (ExTPH/GRO).

Aroclor-1260 was detected in surface and subsurface soil at the DU 3-3. No other PCBs were detected. In surface soil, three samples exceeded the USEPA RSLs for residential and industrial soil. One surface soil sample, TF3-ECH-SB108 (0 to 1 foot depth) also exceeded the GA leachability criteria. The highest concentration was from location TF3-ECH-SB108 on the north side of the ECH structure, by a set of double doors. The second highest concentration was from a location near the main doorway on the south side of the building. In subsurface soil, Aroclor-1260 was detected in six samples. Of those six detections, one sample exceeded the USEPA RSL for residential and industrial soil (TF3-ECH-SB108; 2 to 4 foot depth) and one sample to the northeast of TF3-ECH-SB108 exceeded the USEPA RSL for residential soil only (TF3-ECH-SB109; 2 to 4 foot depth). No subsurface soil samples exceeded the GA leachability criteria.

Aluminum, arsenic, chromium, cobalt, iron, manganese, and thallium were detected in surface soil and subsurface soil at concentrations exceeding the USEPA RSLs for residential soil. Of those parameters, arsenic and chromium concentrations in surface and subsurface soil were also detected above USEPA RSLs for industrial soil. The background comparison concluded that aluminum and arsenic concentrations in surface soil were consistent with background concentrations. However, cobalt, iron, and manganese were detected at concentrations greater than background concentrations in surface soil. In subsurface soil, aluminum, arsenic, chromium, cobalt, and iron were detected at concentrations greater than background. However, manganese concentrations were considered consistent with background. Metals concentrations appeared consistent across the site with the some exceptions.

Low levels of ExTPH contamination were detected in several samples at DU 3-3. TF3-ECH-SB108 (0 to 1 feet bgs; 550 mg/kg) was the only location where concentrations exceeded the RIDEM residential DEC and GA leachability criterion of 500 mg/kg. This sample is located outside the doors on the north side of the building and is likely associated with incidental transformer oil releases.

1.3.6 Fate and Transport

When a contaminant is released into environmental media, the fate and transport are dependent on numerous factors. Physical and chemical properties associated with the environmental media can affect the distribution and behavior of contaminants. Additionally, the properties of the constituent can impact the fate and transport.

At DU 3-1, PAHs and metals had the most exceedances in surface and subsurface soil, followed by dioxins. At DU 3-2, elevated PCB concentrations were identified in surface soil and elevated PAH concentrations were observed in subsurface soil. Additionally, elevated PCB and metal concentrations were identified in surface and subsurface soil at DU 3-3.

PAHs

Most PAHs have low to no volatility and are not soluble. PAHs, such as naphthalene which was detected above the GA leachability criterion, tend to sorb to soil particles and gradually leach through the soil column by means of precipitation and/or infiltration. PAHs present in ground surface may be transported over land through surface water runoff during precipitation events or through wind erosion. However, transport via wind erosion is not considered a significant transport process due to the vegetative cover present at Site 11 – Tank Farm 3. Biodegradation of PAHs is also possible, but a slow process.

Although PAH concentrations frequently exceeded the RSLs, the concentrations were relatively low. No overburden aquifer is present in the area of the AOCs. Given the low solubility of PAHs and lack of direct contact from soil to groundwater, the chance of PAHs leaching from soil to groundwater seems unlikely.

Metals

Both fill and natural soils are present on Aquidneck Island. The presence of metals in soil can often be attributed to background concentrations and is not necessarily indicative of contamination. At DU 3-1 and 3-3, metal concentrations exceeded RSLs. The results of the background analysis revealed that certain metal concentrations were consistent with background concentrations, while other metal concentrations may be anthropogenic in nature.

Metals are non-volatile. Depending on their chemical properties, some metals are soluble and some metals are insoluble. Soluble metals can leach from surface to subsurface soil by means of infiltration. If the appropriate chemical and physical conditions are met, metal contamination in soil could reach the underlying groundwater. In overburden aquifers, soluble metal concentrations may also leach from soil to groundwater through the seasonal rise and fall of the water table. However, an overburden aquifer is not present at DU 3-1, 3-2, and 3-3.

PCBs

At DU 3-2, Aroclor-1242, Aroclor-1254, and Aroclor-1260 concentrations in a subset of surface soil samples exceeded USEPA RSLs for residential soil. Aroclor-1254 and Aroclor-1260 were detected in subsurface soil, but at concentrations below the USEPA RSLs. At DU 3-3, Aroclor-1260 was detected in surface and subsurface soil at concentrations above the USEPA RSLs. In general, PCB concentrations were greater in surface soil than subsurface soil.

Since PCBs are insoluble and tend to sorb to soil, PCB concentrations are relatively immobile. This is demonstrated by the higher surface soil concentrations and the lack of detections in groundwater. PCBs do biodegrade, but at a very low rate.

Dioxin

Dioxins were detected in surface and subsurface soil at DU 3-1. Dioxins tend to have low vapor pressure, low solubility, and high hydrophobicity. Based on these properties, dioxins tend to sorb to soil and vertical mobility in soil is low. As such, leaching to groundwater is unlikely (ATSDR, 1998).

Dioxins may have been released into the air during the burning of petroleum sludge. Due to the low vapor pressure and low solubility of dioxins, concentrations in air emissions tend to bind to organic matter and ultimately end up deposited on soils and vegetative surfaces.

1.3.7 Summary of Human Health Risk Assessment

A Human Health Risk Assessment (HHRA) was performed as part of the DGA Report (Tetra Tech, 2015). At the request of the USEPA and RIDEM, DU 3-1, 3-2, and 3-3 were evaluated as one exposure unit. The HHRA evaluated risks to current and potential future receptors from exposures to surface soil and subsurface soil. Potential receptors under current land use are adolescent trespassers and bow hunters. Potential receptors for future land use are adolescent trespassers, bow hunters, construction workers, industrial workers, child and adult recreational users, and hypothetical child and adult residents. The following text discusses the risk to human health associated with soil at DU 3-1, 3-2, and 3-3.

As part of the data evaluation, Chemicals of Potential Concern (COPCs) were selected by comparing the maximum detection in a sampled medium to risk-based concentrations (RBCs). If the maximum detection was greater than the lowest RBC, the analytical parameter was retained as a COPC. The following COPCs were retained in soil at Site 11 – Tank Farm 3:

- PAHs (benzo(a)pyrene)
- PCBs (Aroclor-1242, Aroclor-1254, and Aroclor-1260)
- Dioxins/Furans (1,2,3,4,6,7,8,9-OCDD, 1,2,3,4,6,7,8-HPCDD, 1,2,3,4,6,7,8-HPCDF, 1,2,3,6,7,8-HXCDD, 1,2,3,6,7,8-HXCDF, 1,2,3,7,8,9-HXCDD, 1,2,3,7,8-PECDD, and 2,3,7,8-TCDD equivalents)
- Metals (chromium, cobalt, iron, manganese, and thallium)

Non-cancer hazards were less than or equal to the USEPA target Hazard Index (HI) of 1 for all receptors with the exception of the hypothetical child resident exposed to surface soil. Dioxins were the major contributors to the HI associated with hypothetical child resident exposure to surface soil.

Cancer risks were above the USEPA's target risk range of 10^{-4} to 10^{-6} for hypothetical child and lifelong residents exposed to surface soil and all soil. Primary risk drivers for surface soil include Aroclor-1260, dioxins, chromium, and benzo(a)pyrene. Primary risk drivers for all soil include Aroclor-1260, arsenic, chromium, dioxins, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene.

Note that during the screening evaluation, chromium was assumed to be hexavalent chromium based on direction given by USEPA Region I for scenarios where chromium speciation is not available. There is no historical evidence of hexavalent chromium use at the site, nor any expectation that the detected chromium is hexavalent chromium. If the chromium were evaluated as trivalent chromium, it would not have been retained as a contaminant of concern (COC). However, until chromium speciation is performed, chromium is maintained as a potential COC.

1.3.8 Summary of Ecological Risk Assessment

An Ecological Risk Assessment (ERA) was performed as part of the DGA Report (Tetra Tech, 2015). The ERA evaluated surface soil data collected from the Site. The following text discusses the risk ecological receptors associated with soil at DU 3-1, 3-2, and 3-3.

Based on the initial screening of the chemical data, several chemicals were initially selected as COPCs in surface soil because they were either detected at concentrations that exceeded conservative screening levels, they had an Ecological Effects Quotient (EEQ) greater than 1.0 in the conservative food chain model, or because they did not have screening levels.

These chemicals were then further evaluated to refine the list of COPCs as Step 3a of a baseline ERA. Risks to ecological receptors exposed to surface soil were evaluated for three separate exposure areas (DU 3-1, 3-2, and 3-3).

No chemicals were retained as COCs for risks to terrestrial plants and soil invertebrates.

Aroclor-1260 was retained as a COC for potential risks to mammals and birds at DU 3-3. The LOAEL EEQs for Aroclor-1260 for the robin (1.1) and the shrew (1.1) were only slightly greater than 1.0. No other chemicals were retained as COCs for risks to birds and mammals in any of the other areas.

1.3.9 Conceptual Site Model Summary

As discussed in Section 1.0, this FS focuses exclusively on DU 3-1, 3-2, and 3-3 and the COCs in soil requiring the consideration of a CERCLA response action. Although petroleum hydrocarbons concentrations are discussed in this Section, the Navy will handle residual TPH, not otherwise addressed by the CERCLA response action, under the RIDEM UST and remediation regulations.

DU 3-1

Source: DU 3-1 is a former sand filter/burning chamber where petroleum bottom sediment and water from USTs were processed. The sand filter would become clogged with petroleum and would periodically be burned. Suspected by-products of burning that could be present at DU 3-1 included VOCs, PAHs, metals, and dioxins/furans. During the DGA, concentrations of PAHs, metals, dioxins, and petroleum hydrocarbons exceeded screening levels. PAHs, metals, and dioxins detections were widespread. Benzo(a)pyrene exceedances were observed in in the majority of surface soil and subsurface soil samples. Metals were detected above screening criteria in every sampling location. However, dioxins were detected above the screening criterion less frequently (three surface soil samples and five subsurface soil samples). Low levels of ExTPH contamination were also detected in several samples across DU 3-1. However, TF3-001-SB103 (6 to 8 feet bgs; 2,350 mg/kg [average between sample and associated field duplicate]) was the only location where concentrations exceeded the RIDEM residential DEC and GA leachability criteria.

Interaction: The primary source medium for exposure is surface and subsurface soil. Contamination in surface and subsurface soil could potentially migrate into groundwater through infiltration.

Receptors: Potential human receptors for contaminants in surface soil and subsurface soil include hunters (a seasonally restricted recreational use), adolescent trespassers, future industrial workers, future construction workers, future recreational users (child and adult), and hypothetical future residents (child and adult). Potential ecological receptors include soil invertebrates, terrestrial vegetation, and birds and mammals.

Summary of Risks: The DGA Report determined that there is predicted human health risk above the USEPA target risk range for surface and subsurface soil at DU 3-1, 3-2, and 3-3 combined, under a hypothetical child and lifelong resident scenario. The ERA did not identify unacceptable ecological risk at DU 3-1.

DU 3-2

Source: At DU 3-2, CERCLA contaminants (PCBs) were previously detected in soils in the area of pad mounted electrical transformers. During the DGA, all soil samples were analyzed for PCBs. In addition to PCBs, two subsurface soil samples were analyzed for PAHs and VOCs after finding pieces of oil-soaked wood and/or soil with a moth-ball like odor at depth. Concentrations of PCBs and PAHs exceeded screening criteria. Aroclor-1242, Aroclor-1254, and Aroclor-1260 concentrations in a subset of surface soil samples exceeded USEPA RSLs for residential soil. Additionally, Aroclor-1254 and Aroclor-1260 concentrations in a smaller subset of surface soil samples exceeded the USEPA RSLs for industrial soil. Several PAHs were detected in subsurface soil at the two locations where oil-soaked wood was observed. Of the detected PAHs, four PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene) exceeded USEPA RSLs for residential soil and industrial soil. Additionally, indeno(1,2,3-cd)pyrene and naphthalene exceeded the USEPA RSLs for residential soil.

Interaction: The primary source medium for exposure is surface and subsurface soil. Contamination in surface and subsurface soil could potentially migrate into groundwater through infiltration.

Receptors: Potential human receptors for contaminants in surface soil and subsurface soil include hunters (a seasonally restricted recreational use), adolescent trespassers, future industrial workers, future construction workers, future recreational users (child and adult), and hypothetical future residents (child and adult). Potential ecological receptors include soil invertebrates, terrestrial vegetation, and birds and mammals.

Summary of Risks: The DGA Report determined that there is predicted human health risk above the USEPA target risk range for surface and subsurface soil at DU 3-1, 3-2, and 3-3 combined, under a hypothetical child and lifelong resident scenario. The ERA did not identify unacceptable ecological risk at DU 3-2.

DU 3-3

Source: DU 3-3 contained electrical equipment, a transformer, and batteries that may have caused metals and PCB contamination. During the DGA, soil samples were analyzed for PCBs, metals, and petroleum hydrocarbons (ExTPH/GRO). PCBs, metals, and petroleum hydrocarbons were detected in soil at concentrations above screening criteria. Aroclor-1260 was the only PCB detected in surface and subsurface soil at DU 3-3. In surface soil, three samples exceeded the USEPA RSLs for residential and industrial soil. One surface soil sample, TF3-ECH-SB108 (0 to 1 foot depth) also exceeded the GA leachability criteria. In subsurface soil, one sample exceeded the USEPA RSL for residential and industrial soil (TF3-ECH-SB108; 2 to 4 foot depth) and one sample exceeded the USEPA RSL for residential soil only (TF3-ECH-SB109; 2 to 4 foot depth). The highest concentration was from location TF3-ECH-SB108 on the north side of the ECH structure, by a set of double doors. Metals were detected in surface soil and subsurface soil at concentrations exceeding the USEPA RSLs for residential soil. Of those parameters, arsenic and chromium concentrations in surface and subsurface soil were also detected above USEPA RSLs for industrial soil. Metals concentrations appeared consistent across the site with the some exceptions. Low levels of ExTPH contamination were detected in several samples at DU 3-3. TF3-ECH-SB108 (0 to 1 feet bgs; 550 mg/kg) was the only location where concentrations exceeded the RIDEM RDEC and GA leachability criteria.

Interaction: The primary source medium for exposure is surface and subsurface soil. Contamination in surface and subsurface soil could potentially migrate into groundwater through infiltration.

Receptors: Potential human receptors for contaminants in surface soil and subsurface soil include hunters (a seasonally restricted recreational use), adolescent trespassers, future industrial workers, future construction workers, future recreational users (child and adult), and hypothetical future residents (child and adult). Potential ecological receptors include soil invertebrates, terrestrial vegetation, and birds and mammals.

Summary of Risks: The DGA Report determined that there is predicted human health risk above the USEPA target risk range for surface and subsurface soil at DU 3-1, 3-2, and 3-3 combined, under a hypothetical child and lifelong resident scenario. As part of the ERA, Aroclor-1260 was also retained as a COC for potential risks to mammals and birds at DU 3-3.

2.0 DEVELOPMENT OF REMEDIATION CRITERIA AND SCREENING OF TECHNOLOGIES

Based on the results of the DGA Report, contaminants identified at DU 3-1, 3-2, and 3-3 pose risk to human and ecological receptors (DU 3-3 only) and may require remediation. In order to best select remediation approaches, criteria are developed based on applicable regulatory requirements, guidance classified as "to be considered" (TBC), and risk-based concentrations of contaminants present at the site. The remediation criteria are presented as Remedial Action Objectives (RAOs), supported by numeric cleanup goals called Preliminary Remediation Goals (PRGs) and regulatory requirements (ARARs). Section 2.1 identifies chemical-, location-, and action-specific ARARs. Section 2.2 provides the basis for and selection of RAOs and Section 2.3 presents site-specific PRGs for soil at DU 3-1, 3-2, and 3-3.

2.1 Identification of Preliminary of ARARs and Criteria to be Considered (TBCs)

ARARs consist of federal and state human health and environmental requirements and guidelines that may affect implementation of remedial alternatives. CERCLA, as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA), 42 U.S.C. § 6901 *et seq.*, and the NCP, 40 C.F.R. Part 300, require identification of all potential ARARs that must be addressed by the USEPA or parties undertaking the remedial action. Determination of ARARs is site-specific and depends on the chemical contaminants, site/location characteristics, and remedial actions being investigated for site cleanup.

CERCLA governs the liability, cleanup, financial responsibility, and response for hazardous substances released into the environment. CERCLA requires that all remedial actions be consistent with the NCP. The NCP specifies procedures, techniques, materials, equipment, and methods to be employed in identifying, removing, or remediating releases of hazardous substances. In particular, the NCP specifies procedures for determining the appropriate type and extent of remedial action at a site in order to effectively mitigate and minimize damage to, and provide adequate protection of, human health, welfare, and the environment.

The national goal of remedy selection is to protect human health and the environment, to maintain that protection over time, and to minimize untreated waste (40 CFR Part 300.430 of the NCP (55 FR 8846)). In accordance with Section 121(d) of CERCLA, 42 U.S.C. § 9621, site remediation must comply with any standard, requirement, criteria, or limitation under any Federal environmental law, except where waived. Substantive State environmental and facility siting requirements must also be attained, under Section 121(d)(2)(c) of CERCLA, 42 U.S.C. § 9621, if they are legally enforceable and consistently enforced statewide, and if the state ARAR is more stringent than the federal ARAR and has been presented to the USEPA in a timely manner. Waiver conditions that may be used, if protection of human health and the environment is to be ensured, include the following:

- The remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed.
- Compliance with such requirements is technically impracticable from an engineering perspective.
- Compliance with such requirement at that facility will result in greater risk to human health and the environment than alternative options.
- The remedial action selected will attain, through use of another method or approach, a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation.
- In the case of a remedial action to be undertaken solely under Section 104 of CERCLA, 42 U.S.C. § 9604, selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration, and the availability of money from the fund to respond to other sites, taking into consideration the relative immediacy of such threats.
- With respect to a state standard, requirement, criteria, or limitation, the state has not consistently applied (or demonstrated the intention to consistently apply) the standard, requirement, criteria, or limitation in similar circumstances at other remedial action sites within the state.

Section 121(e) of CERCLA, 42 U.S.C. § 9621, codified in the NCP at 40 CFR Part 300.400(e), exempts any response action conducted entirely at the site from having to obtain a federal, state, or local permit, where the action is carried out in compliance with Section 121. Remedial actions conducted on CERCLA sites need comply only with the substantive aspects of ARARs and not with the corresponding administrative requirements.

2.1.1 Definition of ARARs and TBCs

As defined by the NCP, ARARs are placed into two classifications: applicable requirements and relevant and appropriate requirements. Applicable requirements are promulgated statutory or regulatory cleanup standards and environmental protection criteria that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. Included are federal requirements that are directly applicable, as well as those incorporated by a federally authorized state program. State standards that are more stringent than federal requirements may be applicable. Relevant and appropriate requirements are promulgated statutory or regulatory cleanup standards and environmental protection criteria that while not directly "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address similar situations or problems to those encountered. Other environmental and public health guidelines which may be considered to help determine remedial alternatives, but are not ARARs, are termed To Be Considered (TBC). A requirement may be either "applicable" or "relevant and appropriate," but not both. Three categories of ARARs are considered: chemical-specific, location-specific, and action-specific.

2.1.2 Chemical-Specific ARARs and TBC

Chemical-specific ARARs are numeric values that provide criteria for evaluating concentrations of specific hazardous contaminants and are developed based upon protection of human health and the environment. These values establish the acceptable amount or concentration of a chemical that may be found in or discharged to the environment. The potential chemical-specific ARARs and TBCs that apply to soil associated with DU 3-1, 3-2, and 3-3 are described in Table 2-1a and provide a basis for the numerical values provided in development of site PRGs in Appendix A.

2.1.3 Location-Specific ARARs

Location-specific ARARs serve to protect individual characteristics, resources, and specific environmental features on a site, such as wetlands, water bodies, floodplains, and sensitive ecosystems. Location-specific ARARs may affect or restrict remediation and site activities. Although wetlands, Lawton Brook, and 500-year floodplain are present just east/northeast of the Site 11 – Tank Farm 3 and Narragansett Bay is located to the north across Defense Highway, remedial actions at DU 3-1, 3-2, and 3-3 (other than land use controls) are not anticipated to occur in or within more than 300 feet of these features. Additionally, soil remedial actions (other than land use controls) are not anticipated to occur within the 50-foot perimeter wetland. Although the estimated areas with soil impacts within the DUs appear to be a mix of grassland and shrub land, which is not suitable habitat for the federally threatened Northern Long-eared Bat, this will need to be confirmed during planning for the remedial action. Additionally, actions will be conducted so as not to disturb any hibernating bats that could be using unused structures as hibernacula. There are no known features of historical significance with the DUs. A small portion of the site, including DU 3-1, appears to be located within 200 feet from a shoreline feature; therefore, applicable coastal zone management requirements will be met as needed during the remedial action. Table 2-1b provides a summary of the location-specific ARARs.

2.1.4 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based requirements of activities or processes that may be implemented on a site, including storage, transportation, and disposal methods of hazardous substances as well as construction of facilities or treatment processes. As action-specific ARARs and TBCs are defined by the components of a potential remedy, they will be discussed as appropriate for each remedial alternative during detailed evaluation of alternatives (Section 4.0).

2.2 Development of Remedial Action Objectives

RAOs consist of medium-specific goals for protecting human health and the environment and provide a basis for remedial alternative development and evaluation during the FS process. RAOs for soil were developed based on the results of the HHRA and ERA conducted for the site (Tetra Tech, 2015). ARARs and background considerations were also utilized in developing RAOs.

USEPA guidelines for baseline risks and hazards at a CERCLA site are generally that non-carcinogenic hazard for each target organ should not exceed a total HI of one, and the total receptor ILCR should not exceed the target risk range of 10^{-6} to 10^{-4}. RAOs are limited to media, geographical areas, and chemicals for which estimated risks and hazards exceed USEPA’s risk management criteria. As noted in Section 1.3.7, exposure to surface soil and all soil by a hypothetical future child and lifelong resident results in an exceedance of USEPA’s risk criteria. Additionally, as noted in Section 1.3.8, exposure to surface soil at DU 3-3 by mammals and birds were associated with unacceptable ecological risks. Therefore, RAOs and PRGs are necessary for the soil associated with DU 3-1, 3-2, and 3-3.

Future use of the Site is considered in the formulation of RAOs. The Navy has no plans to transfer the property. Future use of Site 11 – Tank Farm 3 is expected to remain limited in the future, as long as NAVSTA Newport remains active, and industrial and restricted recreational uses are anticipated. Residential use is not a current or planned future use; however, as directed by CERCLA, the FS evaluates remedial action alternatives for the protection of all possible receptors.

The soil RAOs for the protection of human health and the environment are:

- Prevent exposure by future residents to soil containing site contaminants that exceed residential use scenario PRGs at DU 3-1, 3-2, and 3-3.
- Prevent exposure by industrial and restricted recreational users to soil containing site contaminants that exceed industrial scenario PRGs at DU 3-1, 3-2, and 3-3.
- Prevent future migration by soil contaminants to groundwater (soil COCs above RIDEM GA Leachability Criteria) at DU 3-2 and 3-3.

- Prevent exposure by mammals and birds to surface soil containing COCs that exceed ecological PRGs at DU 3-3.

2.3 Development of Preliminary Remediation Goals

The following sections provide a summary of PRG development related to human and ecological exposures at DU 3-1, 3-2, and 3-3. As discussed in Section 1.0, PRGs were not developed for TPH since TPH is not a CERCLA contaminant.

<u>Human Health - Soil</u>

PRGs have been developed for the site to prevent exposure to soils with site-related contaminant concentrations that may present human health risks at Site 11 – Tank Farm 3 (see Table 2-2). PRGs are developed based on an evaluation of risk-based PRGs, background concentrations, practical quantitation limits (PQLs), and other site-specific considerations (e.g., ARARs). If there are established ARARs for chemical-specific concentrations (e.g., federal or state MCLs), these are often selected as PRGs. In the absence of established ARARs, risk-based PRGs are often developed using USEPA guidance in Development of Risk-Based Preliminary Remediation Goals (USEPA, 1991), following the consideration of background concentrations and PQLs.

Human health risk-based PRGs were developed using the equations presented in USEPA's Risk Assessment Guidance for Superfund, Part B: Preliminary Remediation Goals and the methodology used to develop USEPA's Regional Screening Levels. Exposure factors used in the calculation of risk-based PRGs were the same as those used to estimate risks and hazards in the HHRA, except as noted below.

Risk-based PRGs were developed for soil associated with potential future cumulative cancer risks greater than 10^{-4} considering the ingestion, dermal contact, and inhalation exposure pathways in a residential exposure scenario at Tank Farm 3. For those soils, risk-based PRG development was required for each chemical with an individual cancer risk above 10^{-6}. Table 1 in Appendix A.1 presents the summary of the chemicals retained as COCs for soil. As described in Section 1.3.7, these contaminants include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, dioxins/furans (expressed as the 2,3,7,8-TCDD Equivalent), PCBs, arsenic, and hexavalent chromium (see Table 2-2). It should be noted that hexavalent chromium is being maintained as a potential COC until any speciation analysis is performed.

The human health risk-based PRGs developed in Appendix A.1 correspond to target cancer risk levels of 10^{-6}, 10^{-5}, and 10^{-4} and a target non-cancer HQ of 1. For each of the contaminants, risk-based PRGs were calculated using equations and exposure assumptions presented in Appendix A.1, Table 2. As described in Section 1.3.7, in February 2015, a 2014 USEPA directive was updated which changed the default child surface area exposure parameter for the residential receptor (see Table 2 in Appendix A.1; USEPA, 2014). This parameter is slightly different than that used in the HHRA and has been used in the development of the risk-based PRGs. Toxicity values used in the calculation of the risk-based PRGs are presented in Appendix A.1, Tables 3 through 6. Dermal absorption factors associated with each COC are presented in Appendix A.1, Table 7. In June 2015, USEPA classified multiple chemicals as volatile (as defined in the RSLs November 2015 update found at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm) which were previously not. This reclassification resulted in the inclusion of benzo(a)anthracene, dioxins, and PCBs as volatile constituents during inhalation calculations. The chemical-specific volatilization factors used during the PRG development were taken from the RSLs November 2015 update and are presented in Appendix A.1, Table 10.

Intermediate calculations for ingestion, dermal contact, and inhalation exposures are presented in Appendix A.1, Tables 8 through 10, respectively, with an intermediate results table presented in Appendix A.1, Table 11. The human health risk-based soil PRGs for each contaminant are summarized in Appendix A.1, Table 12. The PRGs are selected by considering the ARARs, risk-based PRGs, quantitation limits, and background data. In addition, maximum detected concentrations were compared to RIDEM RDEC, I/C DEC, and GA Leachability Criteria, selected as ARARs for the site (see Appendix A.1, Tables 14 through 16). PRGs were developed for analytes with exceedances of these criteria.

Background concentrations have been established for metals in soils at NAVSTA Newport and Tank Farm 3 using an EPA-approved basewide background study (Tetra Tech, 2008). In the DGA report (Tetra Tech, 2015), it was determined that the Newport Silt Loam background data from the Basewide Background Study Report was appropriate for comparison to site data based upon historical soil maps. Site specific background soil concentrations were calculated for arsenic, lead, and manganese in surface and subsurface soil using the Newport Silt Loam background data set identified in the DGA report. A 95% Upper Prediction Limit was calculated using the USEPA ProUCL software (Version 5.0.00). The background data set and ProUCL output are provided in Appendix A.3.

For the contaminants listed above which were considered risk-drivers, selected PRGs were identified as follows:

1) The lower of the risk-based goals (point-of-departure: cancer risk = 1 x 10^{-6} or HQ = 1) or ARAR (if available) was initially selected;

2) The PRGs selected in Step 1 were compared to site-specific background values (if available and applicable) and the greater of the two values was selected as the interim PRG, as PRGs are typically not set at concentrations below naturally-occurring background concentrations;

3) The interim PRGs selected in Step 2 were evaluated against available site data to estimate the potential extent of remediation. Other potential PRGs (e.g., cumulative cancer risk = 1 x 10^{-5} and ARARs) were evaluated similarly against site data, including a review of the corresponding residual risk associated with the potential PRGs. In addition, as part of the evaluation, residual risks were calculated for soils remaining following removal of samples with exceedances of PRGs for the specific scenario. All of this information was considered to select the site-specific PRGs.

Based on the procedure noted above, Residential PRGs for PAHs generally correspond to a cancer risk of 1 x 10^{-6}, except for naphthalene, which is based on the RIDEM Leachability Criteria assuming protection of GA classified groundwater, and chrysene, which is based on the RIDEM RDEC. The dioxin PRG is based on a cancer risk of 1 x 10^{-6}, lead and manganese PRGs are based on the RIDEM RDEC, and the PCB PRG is based on an USEPA residential guidance value of 1 mg/kg, contained in USEPA's Guidance on Remedial Actions for Superfund Sites with PCB Contamination (USEPA, 1990). Arsenic concentrations in surface soil and manganese concentrations in subsurface soil have been shown to have a higher site-specific background/reference concentration than the RIDEM RDEC and/or lower risk-based PRGs, resulting in the selection of the site-specific background/reference level as a PRG. CERCLA does not extend cleanup jurisdiction over soils at or less than site-specific background levels. Therefore, PRGs for arsenic in surface soil and manganese in subsurface soil are set at background levels.

Tables 14, 15, and 16 of Appendix A.1 present a comparison of maximum detected soil concentrations to the RIDEM DEC and leachability criteria to determine if there were additional analytes which were not risk-drivers, but exceeded ARARs. For the hypothetical residential scenario, chrysene, lead, and manganese had maximum detections which exceeded ARARs, resulting in inclusion on the PRG summary table (Table 12 in Appendix A.1).

While the DGA did not show an exceedance of USEPA's target risk criteria for an industrial/commercial (I/C) receptor and restricted recreational user (bow hunter), the applicability of the RIDEM Remediation Regulations as an ARAR (see Section 2.1) resulted in review of maximum detected chemical concentrations as compared to the RIDEM I/C DEC and GA Leachability criteria. Tables 14, 15, and 16 of Appendix A.1 present this comparison as part of development of PRGs appropriate for an industrial use scenario. Benzo(a)pyrene, naphthalene, PCBs, and arsenic exceeded the criteria noted. CERCLA does not extend cleanup jurisdiction over soils at or less than site-specific background levels. Therefore, the PRG for arsenic in surface soil is set at background level.

USEPA requires that risks and hazards associated with the selected PRGs for each medium and receptor population be calculated to ensure that these cumulative residual risks meet USEPA acceptable risk range.

Appendix A.1, Table 13 presents calculations for residual human health risks associated with the hypothetical residential and industrial worker soil exposure scenarios associated with Tank Farm 3. The calculation of residual risks uses the exposure factors described above and assumes that soils in this area are remediated to reflect an exposure point concentration equal to the selected PRG.

Table 2-2 presents the PRGs selected, and basis for selection, as appropriate for the residential use and industrial use scenarios.

Ecological - Soil

This section provides a summary of PRG development related to ecological exposures at DU 3-3.

Based on the conclusion in the DGA to further assess Aroclor-1260 at DU 3-3, ecological PRGs have been developed for the site to prevent exposure to soils with site-related contaminant concentrations that may present risks to ecological receptors (Table 2-2). Risk-based PRGs were developed for insectivorous receptors exposed to PCBs in soil associated with DU 3-3.

Ecological risk-based PRGs were developed using the food web equations presented in the DGA report (Tetra Tech, 2015). The ecological risk-based PRGs developed in Appendix A.2 correspond to a hazard quotient (HQ) of 1. PRGs were developed for two insectivorous receptors, the short-tailed shrew and the American robin based on the exposure assumptions (e.g., body weight, ingestion rate, bioaccumulation factor) used in the Tier 2, Step 3A food web model in the DGA report (Tetra Tech, 2015). PRGs were developed using the geometric mean of the toxicity reference values (TRVs) based on both no observed adverse effects levels (NOAELs) and lowest observed adverse effects levels (LOAELs). Due to the small size of DU 3-3 (approximately 0.1 acres), it is assumed that the shrew and robin obtain only a portion of their diets from within the exposure area.

As indicated in Appendix A.2, PRGs are calculated for each receptor based on the geometric mean of the NOAEL- and the LOAEL-based TRVs and an area use factor (AUF) of 0.1 (assumes each receptor obtains 10% of their diet from DU 3-3). DU 3-3 encompasses approximately 0.1 acres and includes the structure and associated roadways. Given that a mix of shrubland, grassland, and forest are present nearby, it seemed unlikely that DU 3-3 would be preferentially selected as a foraging area for the robin and shrew. Therefore, assuming 10% of the diet from DU 3-3 seemed reasonable for the derivation of the PRGs.

Typically, risk managers consider the range of PRGs derived for multiple receptors and different levels of protection. Based on the relatively small size of DU 3-3, the low quality habitat available, and the conservative nature of the food web (i.e., use of NOAELs, exclusive invertebrate diet assumed), a PRG based on a NOAEL-based TRV would be overly protective. Therefore, the geometric mean of the NOAEL- and LOAEL-based TRVs was determined to be appropriate for the derivation of the PRGs. The lower of the PRGs derived for the short-tailed shrew and the American robin is recommended as the ecological PRG for PCBs. This corresponds to a value of 3.6 mg/kg which is the PRG derived based on the short-tailed shrew (Appendix A.2 Table 3).

2.4 Estimation of Areas and Volumes

Comparing the available site characterization data from the DGA to the RAOs and PRGs developed in this Section, estimated quantities of contaminated soil can be quantified. For all soil alternatives, with the exception of the No Action alternative, further soil sampling is recommended to fully delineate the extent of soils that exceed PRGs. The following discussion presents the basis of defining the areas and volumes of contaminated soil to be addressed in this FS.

<u>DU 3-1</u>

Tables 2-3a and 2-3b provide a comparison of the DU 3-1 surface and subsurface soil data to the proposed PRGs for surface and subsurface soil, respectively.

Figure 6 shows the soil sample locations with Residential PRG exceedances for hexavalent chromium, and/or manganese. Additionally, one subsurface sample locations exceeds the Industrial PRG for arsenic. The extent of soil impacted by metals has not been defined either laterally or vertically and as discussed earlier, the metals concentrations do not appear to show any pattern and are not likely the result of any localized spill or any other types of releases that might have occurred during former operations at DU 3-1. The extent of metals impacts should be further evaluated through further sampling. Further, chromium speciation should be conducted on surface soil samples during future sampling and if hexavalent chromium is determined not to be present, it would be eliminated as a COC.

Figure 7 shows the soil sample locations with Residential PRG exceedances for dioxins. As shown on Figure 7, 6 sample locations exceeded the PRG for dioxins. However, the extent of impacts due to dioxins has not been fully delineated either laterally or vertically and should be further evaluated through further sampling.

Figure 8 presents the soil sample locations where PAHs exceeded Residential PRGs. As shown on Figure 8, 6 sample locations exceeded the PRG for benzo(a)pyrene. Benzo(a) pyrene was the only PAH that exceeded PRGs. Additionally, no samples exceeded the Industrial PRGs. The extent of soil impacted by PAHs has not been defined either laterally or vertically and should be further evaluated through further sampling.

Figure 9 summarizes all soil sample locations that have PRG exceedances for metals, dioxins, and/or PAHs and shows an estimated extent of soil impacts for the purpose of evaluating remedial alternatives. Note that there are no Ecological PRGs for DU 3-1, since the DGA Report concluded that there were no unacceptable risks to ecological receptors at DU 3-1.

- Industrial PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 150 square feet is estimated, based on the data collected in the DGA report. The impacted volume of subsurface soil is estimated to be approximately 28 cubic yards based on an assumed average 5 foot depth of impact (2 to 7 feet bgs based on current data showing impacts from 4 to 6 feet bgs). This volume encompasses the subsurface soil that exceeds Industrial PRGs.
- Residential PRGs: For the purpose of evaluating remedial alternatives, an impacted area approximately 4,280 square feet or 0.1 acres is estimated, based on the data collected in the DGA report. Assuming an average depth of 5 feet (current data shows impacts from the ground surface to 1 to 8 feet bgs), the impacted volume of soil is estimated to be approximately 793 cubic yards.

<u>DU 3-2</u>

Table 2-4 provides a comparison of the DU 3-2 soil data to the proposed PRGs.

Figure 10 shows the soil sample location with PRG exceedances for PAHs. Benzo(a)pyrene and naphthalane concentrations exceeded the Residential and Industrial PRGs. Benzo(a)anthracene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene concentrations also exceeded the Residential PRGs. Only one sample, TF3-020-SB107-0204, had PAH concentrations exceeding PRGs. However, only two samples were analyzed for PAHs based on observations of pieces of oil-soaked wood and/or soil with a moth ball-like odor. The extent of oil-soaked wood and/or soil and associated PAH impacts should be further evaluated through further sampling.

Figure 11 shows the soil sample locations with Residential PRG exceedances for PCBs. As shown on Figure 11, 4 sample locations exceeded the PRG for PCBs. However, the extent of impacts due to PCBs has not been fully delineated laterally and should be further evaluated through further sampling.

Figure 12 summarizes all soil sample locations that have PRG exceedances for PAHs and/or PCBs and shows an estimated extent of soil impacts for the purpose of evaluating remedial alternatives. Although PRG exceedances were not observed at TF3-020-SB102B, remedial actions are recommended to address the oil-soaked wood. Note that there are no Ecological PRGs for DU 3-2, since the DGA Report concluded that there were no unacceptable risks to ecological receptors at DU 3-2.

- Industrial PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 175 square feet is estimated, based on the data collected and oil-soaked wood observed in the DGA report. The impacted volume of soil is estimated to be approximately 32 cubic yards based on an assumed average 5 foot depth of impact (current data shows impacts from 2 to 4 feet bgs). This volume encompasses the soil that exceeds Industrial PRGs (including the RIDEM GA Leachability Criterion for naphthalene).
- Residential PRGs: For the purpose of evaluating remedial alternatives, an impacted area approximately 415 square feet is estimated, based on the data collected and oil-soaked wood observed in the DGA report. Assuming an average depth of 5 feet (current data shows impacts from the ground surface to 1 to 4 feet bgs), the impacted volume of soil is estimated to be approximately 77 cubic yards. This area encompasses the soil that exceeds Residential PRGs (including the RIDEM GA Leachability Criterion for naphthalene).

<u>DU 3-3</u>

Tables 2-5a and 2-5b provide a comparison of the DU 3-3 surface and subsurface soil data to the proposed PRGs for surface and subsurface soil, respectively.

Figure 13 shows the soil sample location with a PRG exceedance for lead. One sample, TF3-ECH-SS103-0001 contained lead concentrations exceeding the Residential PRG. Note that the subsurface soil sample collected 2 to 4 feet at the same location did not exceed the Residential PRG.

Figure 14 shows the soil sample locations with PRGs exceedances for PCBs. As shown on Figure 14, 3 sample locations exceeded the PRG for PCBs. One sample, TF3-ECH-SS108-0001, exceeded the Residential, Industrial, and Ecological PRGs. The extent of impacts due to PCBs has not been fully delineated either laterally or vertically and should be further evaluated through additional sampling.

Figure 15 summarizes all soil sample locations that have PRG exceedances for metals and/or PCBs and shows an estimated extent of soil impacts for the purpose of evaluating remedial alternatives.

- Industrial PRGs: For the purpose of evaluating remedial alternatives, an impacted area totaling approximately 150 square feet is estimated, based on the data collected in the DGA report. The impacted volume of soil is estimated to be approximately 28 cubic yards based on an assumed average 5 foot depth of impact (current data shows impacts from the ground surface to 4 feet bgs). This volume encompasses the soil that exceeds Industrial PRGs (including the RIDEM GA Leachability Criterion for PCBs).
- Residential PRGs: For the purpose of evaluating remedial alternatives, an impacted area approximately 2,070 square feet is estimated, based on the data collected in the DGA report. Assuming an average depth of 2 feet (current data shows impacts mainly in top 1 foot), the impacted volume of soil is estimated to be approximately 153 cubic yards. This area encompasses the soil that exceeds Residential PRGs (including the RIDEM GA Leachability Criterion for PCBs).
- Ecological PRGs: For the purpose of evaluating remedial alternatives, the estimated area and volume of soils that exceeds the Ecological PRG, based on the data collected in the DGA report, is the same as that identified above for Industrial PRGs.

2.5 General Response Actions

General response actions are developed to satisfy the RAOs for the site. The range of applicable general response actions for soil at DU 3-1, 3-2, and 3-3 are as follows:

- No Action
- Limited Action (land use controls [LUCs])
- Containment

- Removal
- Disposal
- Treatment

No remedial activities would be implemented under the No Action response action. However, per the NCP and CERCLA RI/FS guidance, it is considered throughout the FS process as a baseline against which other alternatives can be compared.

2.6 Identification and Screening of Technology Types and Process Options

A preliminary list of potential remedial technologies has been developed for each of the general response actions listed in Section 2.5. These remedial technologies and associated process options are presented and screened in this subsection. Several factors were used to determine feasibility and, in turn, to screen out those technologies that clearly should not be considered for use at the site. The factors used in this screening process were based on the current USEPA guidance for conducting RI/FSs under CERCLA and included, but were not limited to, the following:

- Effectiveness in handling the estimated areas or volumes of media and in meeting the PRGs
- Potential impacts to human health and the environment during construction and implementation
- Proven effectiveness and reliability with respect to the contaminants and conditions at the site
- Implementability in terms of both the technical and administrative feasibility
- Relative costs as far as technologies or process options that accomplish the same result

Table 2-6 presents technology and process option screening for soil. The table presents a brief technology description and the justification for the elimination or further consideration of each technology.

3.0 DEVELOPMENT AND SCREENING OF SOIL ALTERNATIVES

Remedial alternatives for surface and subsurface soil at DU 3-1, 3-2, and 3-3 are developed in the following sections. Remedial technologies not screened from further consideration in Section 2.6 have been used as the basis for developing potential site-specific remedial alternatives listed in this section. Feasible remedial technologies and process options have been combined into comprehensive site remedial alternatives that address the RAOs detailed in Section 2.2.

3.1 Development of Soil Alternatives

The remedial alternatives for the impacted soil in the proximity of DU 3-1, 3-2, and 3-3 are discussed below and are also summarized in Table 3-1. Further details are provided in Section 4.0 (Detailed Evaluation) for those alternatives which survive the screening process (Section 3.2).

3.1.1 Alternative S-1 – No Action

This alternative is used as a baseline for comparison to the other alternatives in accordance with the NCP (USEPA, 1990) and RI/FS guidance (USEPA, 1988). There are no remedial actions involved with this alternative.

3.1.2 Alternative S-2 – Limited Soil Excavation with Land Use Controls

Under this alternative, limited soil excavation and off-site disposal would remove all surface and subsurface soils exceeding the Industrial PRGs (including RIDEM GA Leachability Criterion) for DU 3-2 and 3-3. Limited soil excavation and off-site disposal would also remove soils exceeding the Ecological PRG at DU 3-3. LUCs would be established to address direct exposure to soil exceeding Residential PRGs at DU 3-1, 3-2, and 3-3 and subsurface soil exceeding the Industrial PRG for arsenic at DU 3-1. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy. As part of LUCs, a series of documented controls along with site inspections would be conducted to prevent residential use of the property.

TPH is not a CERCLA-regulated contaminant and therefore no PRGs were developed in this FS; however, at locations where TPH exceedances are co-located with CERCLA PRG exceedances, the CERCLA response action will address TPH as well. At DU 3-1, this alternative includes LUCs only at DU 3-1 to meet the Residential and Industrial PRGs; however, LUCs would not address the residual

TPH concentrations above the RIDEM GA leachability criterion. Rather, the Navy will address the residual TPH under the RIDEM UST and remediation regulations. At DU 3-3, this alternative includes soil excavation to remove soils exceeding the Industrial and Ecological PRGs and it is expected that this action will also remove the co-located TPH to below RIDEM criteria.

<u>Limited Excavation</u>

At DU 3-2, one soil sample (TF3-020-SB107-0204) exceeded the Industrial PRGs. The RIDEM GA Leachability Criteria served as the basis of the Industrial PRG for naphthalene. Additionally, oil-soaked wood was identified at two sample locations and would be removed as part of the excavation. Estimated areas and volumes are summarized in Section 2.4.

At DU 3-3, all surface and subsurface soil exceeding the Ecological and/or Industrial PRGs (including GA leachability criteria) will be removed. A total of two samples (TF3-ECH-SS108-0001 and TF3-ECH-SB108-0204) from one soil boring exceeded the PRG for PCBs. PCB concentrations exceeded the Industrial and Ecological PRGs at TF3-ECH-SS108-0001. At TF3-ECH-SB108-0204, PCB concentrations exceeded the Ecological PRG. Estimated areas and volumes are summarized in Section 2.4.

Pre-design soil sampling will be needed to delineate the extent of soils that exceed PRGs at DU 3-1, 3-2, and 3-3. Further sampling would also include analysis for hexavalent chromium at a few locations at DU 3-1. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC. At DU 3-2, test pitting will be performed to identify the extent of oil-soaked wood at TF3-020-SB102B and TF3-020-SB107 which will be used to guide further sampling for PAHs. At DU 3-1, pre-design soil sampling would also include re-sampling of two 2004 SIRAR subsurface soil locations with elevated TPH and analysis would include the following parameters: VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO). The locations were intended to be re-sampled during the DGA, but it appears that the actual DGA samples were not collected sufficiently close to the historic locations. The results will be compared to the DU 3-1 PRGs and to RIDEM criteria.

All excavated soil will be stockpiled at an approved location. Details regarding stockpile management (e.g., stormwater controls and temporary covers) will be developed during the remedial design phase. Prior to disposal, waste characterization samples will be collected from the stockpiled soil and debris.

Erosion control measures will be required during excavation. Once all contaminated soil and debris is removed, the areas would be backfilled and seeded. An impermeable cover will not be required since the remaining contaminant concentrations would not exceed the RIDEM GA Leachability Criteria.

<u>Land Use Controls</u>

At DU 3-1, 3-2, and 3-3, soil would remain on-site at concentrations greater than the Residential PRGs; therefore, LUCs would be established to prevent residential use and thus prevent the exposure of such receptors to COCs in soil. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. Periodic inspections would also be needed to ensure no change in land use and that the surface soil remains undisturbed in the area where arsenic exceeds the Industrial PRG in the subsurface soil.

Additionally, five-year reviews would be required since contaminants will remain in excess of levels that allow for unrestricted use and unlimited exposure. Five-year reviews of Site 11 – Tank Farm 3 would be conducted as part of the facility-wide five-year review process.

For this remedial alternative, the LUC Remedial Design (RD) will identify the remedial measures to be taken to restrict residential use and to ensure subsurface soils exceeding the Industrial PRG for arsenic at DU 3-1 are not disturbed or contacted in the future. In accordance with the future ROD, LUCs would be monitored and enforced as long as contaminants are present above levels that allow for unrestricted use and unlimited exposure, as determined by the five-year review process.

In cases where LUCs are placed to address contamination at a site, the Navy must submit an annual report to the regulatory agencies documenting that all of the restrictions are being met. The Navy is also required to take immediate action to correct any violations identified. This report must be submitted every year until such time as LUCs are no longer needed.

3.1.3 Alternative S-3 – Containment with Land Use Controls

Under this alternative, an asphalt cover would be placed over soil in excess of the Industrial PRGs (including RIDEM GA Leachability Criterion) at DU 3-2 and 3-3. The cover would also cover soil exceeding the Ecological PRG at DU 3-3. LUCs would also be applied to DU 3-1, 3-2, and 3-3 preventing residential use and to DU 3-3 requiring maintenance of the ECH building foundation. LUCs would be established to address the subsurface Industrial PRG exceedance for arsenic at DU 3-1.

TPH is not a CERCLA-regulated contaminant and therefore no PRGs were developed in this FS; however, at locations where TPH exceedances are co-located with CERCLA PRG exceedances, the CERCLA response action will address TPH as well. At DU 3-1, this alternative includes LUCs only at DU 3-1 to meet the Residential and Industrial PRGs; however, LUCs would not address the residual TPH concentrations above the RIDEM GA leachability criterion. Rather, the Navy will address the residual TPH under the RIDEM UST and remediation regulations. At DU 3-3, this alternative includes an asphalt cover over soils exceeding the Industrial and Ecological PRGs and it is expected that this action will also address the co-located TPH to meet RIDEM criteria.

Pre-design soil sampling will be needed to delineate the extent of soils that exceed PRGs at DU 3-1, 3-2, and 3-3. Further sampling would also include analysis for hexavalent chromium at a few locations at DU 3-1. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC. At DU 3-2, test pitting will be performed to identify the extent of oil-soaked wood at TF3-020-SB102B and TF3-020-SB107 which will be used to guide further sampling for PAHs. At DU 3-1, pre-design soil sampling would also include re-sampling of two 2004 SIRAR subsurface soil locations with elevated TPH and analysis would include the following parameters: VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO). The locations were intended to be re-sampled during the DGA, but it appears that the actual DGA samples were not collected sufficiently close to the historic locations. The results will be compared to the DU 3-1 PRGs and to RIDEM criteria.

During the remedial design, the type of cover system will be selected. This FS proposes an asphalt cover system since it will prevent direct contact, erosion, and transport of remaining soil exceeding Industrial PRGs and Ecological PRGs (DU 3-3 only). This containment system would also minimize the leaching of PAHs and PCBs from soil to groundwater. A native soil or single barrier cap would not minimize the leaching of PAHs and PCBs from soil to groundwater.

An asphalt cover system would be installed at the DU 3-2 and 3-3. The cover would be designed to not interfere with access to the structures. For the purpose of the FS, the cover system would consist of 4 inches of asphalt pavement overlying at least 6 inches of clean sub-base material to prevent direct contact, erosion, and transport of remaining soil exceeding Industrial PRGs and Ecological PRGs (DU 3-3 only). This containment system would also minimize the leaching of PAHs and PCBs from soil to groundwater. The asphalt pavement would be installed to cover assumed impacted areas of 150 square feet at DU 3-2 and 150 square feet at DU 3-3.

Erosion control measures will be required during installation of the cover and until the site is stabilized. LUCs would be applied to the DU 3-2 and 3-3 that restrict cover disturbance and require maintenance of the asphalt cover as well as perform associated inspections, and reporting. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy. LUCs would also be applied to DU 3-1, 3-2, and 3-3 preventing residential use and five-year reviews would be performed to evaluate the success of the remedial actions. Five-year reviews of Site 11 – Tank Farm 3 would be conducted as part of the facility-wide five-year review process.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. Periodic inspections would also be needed to ensure no change in land use and that the surface soil remains undisturbed in the area where arsenic exceeds the Industrial PRG in the subsurface soil.

For this remedial alternative, the LUC RD will identify the remedial measures to be taken to restrict residential use, maintain the integrity of covers at DU 3-2 and 3-3, and to ensure subsurface soils exceeding the Industrial PRG for arsenic at DU 3-1 are not disturbed or contacted in the future. In accordance with the future ROD, LUCs would be monitored and enforced and five-year reviews must be conducted as long as contaminants are present above levels that allow for unrestricted use and unlimited exposure, as determined by the five-year review process.

In cases where LUCs are placed to address contamination at a site, the Navy must submit an annual report to the regulatory agencies documenting that all of the restrictions are being met. The

Navy is also required to take immediate action to correct any violations identified. This report must be submitted every year until such time as LUCs are no longer needed.

3.1.4 Alternative S-4 – Excavation to Residential PRGs and Off-Site Disposal

This alternative involves excavation of the contaminated soils in excess of Residential, Industrial, and Ecological PRGs at DU 3-1, 3-2, and 3-3. Excavated soil will be transported off-site for disposal, reuse, or recycling. LUCs, to include maintenance of the ECH building foundation, would be required at DU 3-3 to prevent access to the soil beneath the building, which has not been assessed. If the building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Residential, Industrial, and Ecological PRGs. Demolition of this building is not considered part of the remedy. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment.

TPH is not a CERCLA-regulated contaminant and therefore no PRGs were developed in this FS; however, at locations where TPH exceedances are co-located with CERCLA PRG exceedances, the CERCLA response action will address TPH as well. At DU 3-1, this alternative includes LUCs only at DU 3-1 to meet the Residential and Industrial PRGs; however, LUCs would not address the residual TPH concentrations above the RIDEM GA leachability criterion. Rather, the Navy will address the residual TPH under the RIDEM UST and remediation regulations. At DU 3-3, this alternative includes soil excavation to remove soils exceeding the Residential, Industrial, and Ecological PRGs and it is expected that this action will also remove the co-located TPH to below RIDEM criteria.

<u>Excavation</u>

The following volumes of soil would be removed from the DUs: 793 cubic yards at DU 3-1, 77 cubic yards at DU 3-2, and 153 cubic yards at DU 3-3. Estimated areas and volumes are described in Section 2.4. Actual quantities would be determined during the RD.

Pre-design soil sampling will be needed to delineate the extent of soils that exceed PRGs at DU 3-1, 3-2, and 3-3. Further sampling would also include analysis for hexavalent chromium at a few locations at DU 3-1. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC. At DU 3-2, test pitting will be performed to identify the extent of oil-soaked wood at TF3-020-SB102B and TF3-020-SB107, which will be used to guide further sampling for PAHs. Oil-soaked wood would be removed as part of the soil excavation. At DU 3-1, pre-design soil sampling would also include re-sampling of two 2004 SIRAR subsurface soil locations with elevated TPH and analysis would include the following parameters: VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO). The locations were intended to be re-sampled during the DGA, but it appears that the actual DGA samples were not collected sufficiently close to the historic locations. The results will be compared to the DU 3-1 PRGs and to RIDEM criteria.

All excavated soil will be stockpiled at an approved location. Details regarding stockpile management (e.g., stormwater controls and temporary covers) will be developed during the remedial design phase. Prior to disposal, waste characterization samples will be collected from the stockpiled soil.

Erosion control measures will be required during excavation. Once all contaminated soil is removed, the areas would be backfilled and seeded. Once the excavation is complete, an impermeable cover will not need to be implemented because the contaminant concentrations would not exceed the RIDEM GA Leachability Criteria.

Land Use Controls

As a conservative measure, since no sampling has been performed underneath the ECH structure, LUCs would likely be required until the ECH structure is demolished and the presence or absence of soil beneath the building can be assessed. LUCs would also include maintenance of the ECH structure foundation. The demolition of the ECH structure is not considered part of this alternative. However, if the building is demolished and the foundation is removed, if underlying soil is present, it would be assessed and remediated if needed to meet Residential and Industrial PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment. LUCs would prevent disturbance of the building foundation without approval of the Navy and regulatory agencies.

As long as the LUCs are needed for the ECH foundation at DU 3-3, five-year reviews will be performed under this alternative to evaluate the continued adequacy of the remedy. The five-year reviews would be performed as part of the facility-wide five year reviews.

In cases where LUCs are placed to address contamination at a site, the Navy must submit an annual report to the regulatory agencies documenting that all of the restrictions are being met. The Navy is also required to take immediate action to correct any violations identified. This report must be submitted every year until such time as LUCs are no longer needed.

3.1.5 Alternative S-5 – In Situ Thermal Desorption

This alternative involves treatment of the contaminated soils in excess of the Industrial PRGs (including RIDEM GA Leachability Criterion) for DU 3-2 and 3-3. The treatment would also address Ecological PRG exceedances at DU 3-3. In addition to the in situ thermal desorption, LUCs would be applied to DU 3-1, 3-2, and 3-3 preventing residential use and to DU 3-3 to require maintenance of the ECH building foundation.

Although one subsurface soil sample at DU 3-1 had arsenic concentrations above the Industrial PRG, treatment is not required in accordance with RIDEM Remediation Regulations. LUCs would be established to address the subsurface Industrial PRG exceedance at DU 3-1.

TPH is not a CERCLA-regulated contaminant and therefore no PRGs were developed in this FS; however, at locations where TPH exceedances are co-located with CERCLA PRG exceedances, the CERCLA response action will address TPH as well. At DU 3-1, this alternative includes LUCs only at DU 3-1 to meet the Residential and Industrial PRGs; however, LUCs would not address the residual TPH concentrations above the RIDEM GA leachability criterion. Rather, the Navy will address the residual TPH under the RIDEM UST and remediation regulations. At DU 3-3, this alternative includes in-situ thermal desorption to treat soils exceeding the Industrial and Ecological PRGs and it is expected that this action will also remove the co-located TPH to below RIDEM criteria.

Pre-design soil sampling will be needed to delineate the extent of soils that exceed PRGs at DU 3-1, 3-2, and 3-3. Further sampling would also include analysis for hexavalent chromium at a few locations at DU 3-1. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC. At DU 3-2, test pitting will be performed to identify the extent of oil-soaked wood at TF3-020-SB102B and TF3-020-SB107 which will be used to guide further sampling for PAHs. At DU 3-1, pre-design soil sampling would also include re-sampling of two 2004 SIRAR subsurface soil locations with elevated TPH and analysis would include the following parameters: VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO). The locations were intended to be re-sampled during the DGA, but it appears that the actual DGA samples were not collected sufficiently close to the historic locations. The results will be compared to the DU 3-1 PRGs and to RIDEM criteria.

The in situ thermal desorption system would be set up at DU 3-2 and 3-3 to address Industrial PRG exceedances for PAHs and PCBs, respectively. The system would also address Ecological PRG exceedances at DU 3-3. The in situ thermal desorption system involves application of heat and vacuum to remove contaminants. The contaminated soil is heated until contaminants change to the vapor phase and separate from the soil. A vacuum is used to extract the vapor created as a result of the heating.

At DU 3-1, 3-2, and 3-3, soil would remain on-site at concentrations greater than the Residential PRGs; therefore, LUCs would be established to prevent residential use and thus prevent the exposure of such receptors to COCs in soil. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. Periodic inspections would also be needed to ensure no change in land use and that the surface soil remains undisturbed in the area where arsenic exceeds the Industrial PRG in the surface soil.

Additionally, five-year reviews would be required since contaminants will remain in excess of levels that allow for unrestricted use and unlimited exposure. Five-year reviews of Site 11 – Tank Farm 3 would be conducted as part of the facility-wide five-year review process.

3.2 Screening of Soil Alternatives

Initial screening of remedial alternatives developed in Section 3.1 is performed in Section 3.2 to initiate the evaluation of each alternative. In addition, the screening process is used to potentially eliminate one or more alternatives that do not appear advantageous to carry through to the detailed evaluation in Section 4.0. This initial screening process includes an assessment of the advantages and disadvantages of each alternative on the basis of their effectiveness, implementability, and cost, in accordance with the RI/FS guidance (USEPA, 1988).

The effectiveness of each remedial alternative was assessed using the following criteria:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reductions in toxicity, mobility, and volume through treatment

- Short-term effectiveness

The implementability of each remedial alternative was assessed using the following criteria:

- Technical feasibility
- Administrative feasibility
- Applicability based on site conditions and layout

The costs were initially assessed using engineering judgment, considering capital costs for equipment and construction and O&M estimates.

Tables 3-2 through 3-6 present the initial screening of the remedial alternatives for Site 11 – Tank Farm 3. Based on this screening, alternatives S-1, S-2, and S-3 were retained for detailed evaluation. Alternatives S-4 and S-5 were removed from further evaluation due to the high costs associated with the alternatives and the limited benefit as compared to the cost of remediation.

4.0 DETAILED ANALYSIS OF SOIL ALTERNATIVES

A detailed evaluation of candidate remedial alternatives is conducted to evaluate each of the alternatives individually, and subsequently apply the evaluation comparatively among them (refer to Section 5.0). The following seven criteria are evaluated during the FS phase of the CERCLA process. Two additional criteria, state and community acceptance, will be evaluated as part of the subsequent regulatory and community review phase.

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

4.1 Alternative S-1 – No Action

4.1.1 Detailed Description

The no action alternative, as required under the NCP, would involve no remedial response activities and would provide no additional protection of human health or the environment; this alternative provides a baseline for comparison to other alternatives.

4.1.2 Criteria Analysis

A detailed discussion of the specific attributes of each FS Criteria is presented below and summarized in Table 4-1.

<u>Overall protection of human health and the environment</u>: Based on the results of the DGA Report, the no action alternative does not provide long-term protection of human health at DU 3-1, 3-2, and 3-3 or the environment at DU 3-3. The alternative does not achieve the RAOs described in Section 2.2.

<u>Compliance with ARARs</u>: Table B-1 in Appendix B presents an evaluation of chemical-specific ARARs and TBCs associated with Alternative S-1. Under current conditions, chemical-specific ARARs and TBCs have not been met. Therefore, this alternative would not meet ARARs.

Long-term effectiveness and permanence: Since no remedial actions would occur under this alternative, the estimated risks to human health and the environment would remain. This alternative does not include any controls to reduce potential exposures to contamination.

Reduction of toxicity, mobility or volume through treatment: This alternative does not involve/ include treatment.

Short-term effectiveness: Since this alternative involves no construction or monitoring measures, there would be no additional short-term risks to workers or the community from the remedy. Additionally, there are no short-term impacts to natural habitats.

Implementability: This alternative would require no implementation.

Cost: No costs would be anticipated under the no action alternative.

4.2 Alternative S-2 – Limited Soil Excavation with Land Use Controls

4.2.1 Detailed Description

Under this alternative, limited soil excavation and off-site disposal would be performed at DU 3-2 and 3-3 to remove soils exceeding the Industrial PRGs (including RIDEM GA Leachability Criteria) and Ecological PRGs (applicable to DU 3-3 only). Additionally, LUCs would be implemented to prevent residential use of the property and to prevent access to subsurface soil exceeding the Industrial PRG for arsenic at DU 3-1. LUCs would also be required at DU 3-3 to include maintenance of the ECH building foundation.

At DU 3-2, one soil boring location (TF3-020-SB107-0204) exceeded the Industrial PRGs. The RIDEM GA Leachability Criteria served as the basis of the Industrial PRG for naphthalene. Additionally, oil-soaked wood was identified at two sample locations and would be removed as part of the excavation. Estimated areas and volumes are summarized in Section 2.4.

At DU 3-3, one soil boring location (TF3-ECH-SS108-0001 and TF3-ECH-SB108-0204) exceeded the PRGs for PCBs. PCB concentrations exceeded the Industrial and Ecological PRGs in the surface soil sample (TF3-ECH-SS108-0001). Estimated areas and volumes are summarized in Section 2.4. Details of each component of Alternative S-2 are as follows.

TPH is not a CERCLA-regulated contaminant and therefore no PRGs were developed in this FS; however, at locations where TPH exceedances are co-located with CERCLA PRG exceedances, the CERCLA response action will address TPH as well. At DU 3-1, this alternative includes LUCs only at DU 3-1 to meet the Residential and Industrial PRGs; however, LUCs would not address the residual

TPH concentrations above the RIDEM GA leachability criterion. Rather, the Navy will address the residual TPH under the RIDEM UST and remediation regulations. At DU 3-3, this alternative includes soil excavation to remove soils exceeding the Industrial and Ecological PRGs and it is expected that this action will also remove the co-located TPH to below RIDEM criteria.

Soil Sampling – Prior to the excavation, sampling will be needed to fully delineate the extent of soils that exceed PRGs at DU 3-2 and 3-3. Sampling will also be needed to better delineate areas that will require LUC at DU 3-1, 3-2, and 3-3 to prevent residential use of the property. Sampling to delineate TPH concentrations will be performed under the RIDEM UST and remediation regulations.

At DU 3-1, soil borings with surface and subsurface soil sampling for dioxins, PAHs, arsenic, and manganese would be conducted in order to delineate contamination that exceeds PRGs. In addition to those samples, several of the previous surface soil sample locations where chromium exceedances were observed will be resampled for hexavalent chromium. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil around DU 3-1 are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC. Pre-design soil sampling would also include re-sampling of two 2004 SIRAR subsurface soil locations with elevated TPH and analysis would include the following parameters: VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO). The locations were intended to be re-sampled during the DGA, but it appears that the actual DGA samples were not collected sufficiently close to the historic locations. The results will be compared to the DU 3-1 PRGs and to RIDEM criteria.

At DU 3-2, soil borings with surface and subsurface soil sampling for PCBs would be conducted at a small number of locations to better delineate the extent of surface soil that exceeds the Residential PRG for PCBs. Additionally, test pitting will be performed to identify the extent of oil-soaked wood that was previously observed in the subsurface at TF3-020-SB102B and TF3-020-SB107. The test pit observations would be used to guide further soil sampling for PAHs to delineate exceedances of Residential and Industrial PRGs.

At DU 3-3, soil borings with surface and subsurface soil sampling for PCBs (and lead at select locations) would be conducted to better delineate the extent of soil impacts above Residential, Industrial, and Ecological PRGs. In addition to those samples, several of the previous surface soil sample locations where chromium exceedances were observed will be resampled for hexavalent chromium. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil around DU 3-1 are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC.

Soil Removal and Disposal – The goal of the removal is to address exceedances of the Industrial PRG and Ecological PRG (applicable to DU 3-3 only). Oil-soaked wood at DU 3-2 would also be removed as part of the soil excavation. Since concentrations of CERCLA contaminants at DU 3-1 are below Industrial PRGs, except for arsenic in subsurface soil, excavation is not proposed. The areas currently targeted for excavation are presented on Figures 12 and 15. The estimated areas and volumes are provided below based on currently available data.

Exposure Area	Area of Proposed Soil Removal (sq. feet)	Volume of Proposed Soil Removal (cubic yards)
DU 3-2	175	32
DU 3-3	150	28

Prior to the excavation, erosion control measures (i.e., silt fences) will be installed around the excavation area. During the excavation, dust control and air monitoring will be performed, as necessary. Once all contaminated soil is removed, the areas would be backfilled to the surrounding grade and seeded.

The excavated soil and debris will be transported and disposed of at an off-site, licensed landfill or treatment facility.

LUCs and Inspections – Following the removal excavation, soil would remain at DU 3-1, 3-2, and 3-3 at concentrations greater than the Residential PRGs; therefore, LUCs, monitoring, and inspections (also described below) will be required to complete the remedy. The intent of LUCs at DU 3-1, 3-2, and 3-3 is to prevent residential use of the property so that contact with COCs at concentrations that would cause an unacceptable risk to human receptors is prevented for the life of the remedy. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. Periodic inspections would also be needed to ensure no change in land use and that the surface soil remains undisturbed in the area where arsenic exceeds the Industrial PRG in the subsurface soil.

Requirements for management of excavated soil as part of any future construction activities (including sampling and disposal of contaminated soils) at DU 3-1, 3-2, and 3-3 would also be included as part of the LUCs. The areas currently targeted for LUCs are presented on Figures 9, 12, and 15. The estimated areas are provided below based on currently available data. These areas will be further refined during the pre-design sampling.

Exposure Area	Area of Proposed LUCs (sq. feet)
DU 3-1	4200
DU 3-2	415
DU 3-3	2070

For this remedial alternative, the LUC RD would prohibit development of the DUs for residential use and prevent access to soil beneath the ECH building at DU 3-3. In accordance with the future ROD, LUCs would be monitored and enforced as long as contaminants are present above levels that allow for unrestricted use and unlimited exposure, as determined by the five-year review process.

The LUC implementation actions including monitoring and enforcement requirements will be provided in a LUC RD that will be prepared by the Navy as the LUC component of the overall RD. Regular site inspections will be performed to verify the continued maintenance of LUCs until the cleanup levels have been achieved.

LUCs will be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions (DoD, 2003), per letter dated January 16, 2004, from Alex A. Beehler, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), and the requirements of the FFA. As long as Navy retains ownership of the property, NAVSTA Newport enforces the LUCs and assures that each LUC is maintained appropriately by tracking it through a centralized tracking system. If the property is transferred from the Navy to another federal owner, upon meeting the requirements for transfers under the site's FFA, Navy would ensure as part of the transfer process that the gaining agency is made aware of the existing controls and would take appropriate action to ensure that such controls remain in place. If the property is ever transferred to non-federal ownership, deed restrictions, meeting state property law standards, would be recorded that would incorporate and land use restrictions. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the soil are at levels that allow for unrestricted use and exposure.

Five-Year Reviews – Contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure at DU 3-1, 3-2, and 3-3; therefore, five-year reviews would be required under this alternative to evaluate the continued adequacy of the remedy. The five-year reviews would be performed as part of the facility-wide five year reviews.

4.2.2 Criteria Analysis

A detailed discussion of the specific attributes of each of the FS Criteria is presented below and summarized in Table 4-2.

Overall protection of human health and the environment: Alternative S-2 would be protective of human health and the environment. The Limited Soil Excavation with Land Use Controls alternative removes soil concentrations exceeding Industrial PRGs (including the RIDEM GA Leachability Criteria) at DU 3-2 and 3-3; thereby, reducing the risk to industrial workers and reducing the potential for PAHs and PCB concentrations to migrate to groundwater at DU 3-2 and 3-3, respectively.

Soil contamination will remain present at DU 3-1, 3-2, and 3-3 above Residential PRGs. At DU 3-1, one subsurface soil sample contains arsenic concentrations above the Industrial PRG. Additionally, soil beneath the ECH building at DU 3-3 has not been assessed. By implementing the LUCs at DU 3-1, 3-2, and 3-3 to prohibit residential use and preventing access to subsurface soil at the portion of DU 3-1 with the Industrial PRG exceedance as well as soil below the building at DU 3-3, contact with COCs at concentrations that would cause an unacceptable risk to human receptors is prevented for the life of the remedy.

Soil contamination exceeding the Ecological PRG for PCBs would be removed from DU 3-3; thereby, reducing the risk to ecological receptors.

Compliance with ARARs: Tables B-2a, B-2b, and B-2c in Appendix B present an evaluation of chemical-specific, location-specific, and action-specific ARARs and TBCs associated with Alternative S-2. With proper execution of this alternative, all chemical-specific ARARs and TBCs will be met and location-specific and action-specific ARARs and TBCs would be complied with.

Long-term effectiveness and permanence: Alternative S-2 would provide permanent long-term protectiveness. By removing the soil concentrations that exceed the Industrial PRGs (including RIDEM GA Leachability Criteria) and the Ecological PRG at DU 3-2 and 3-3, this alternative is effective at reducing the risk to industrial workers, reducing the potential for PAHs and PCB concentrations to migrate to groundwater, and reducing the risk to ecological receptors.

DU 3-1, 3-2, and 3-3 would be suitable for continued use similar to the current use, and LUCs would restrict residential use, under scenarios that could pose unacceptable exposure. Five-year reviews would be conducted to evaluate the continued adequacy of the remedy.

Reduction of toxicity, mobility or volume through treatment: This alternative does not involve/include treatment.

Short-term effectiveness: Alternative S-2 would be effective in the short term as long as work is done properly, with the necessary controls in place. Risks to the community would be minor with the implementation of this alternative. During excavation and environmental monitoring, short-term risks to workers would be mitigated through use of proper personal protective equipment (PPE). Additionally, minor short-term impacts to the ecological habitat would occur during environmental sampling and excavation. Alternative S-2 would be effective immediately after implementation.

Implementability: Initial implementation of Alternatives S-2 is not complicated given the site conditions and low concentrations of contaminants, based on the currently assumed extents. Excavation and LUCs are proven technologies used to address soil contamination at a site. The resources required for implementation of this alternative are readily available. Additionally, the preparation and implementation of a LUC RD would require administrative processes that can be easily implemented.

Cost: As part of this alternative, costs are associated with the excavation, environmental sampling, implementation of LUCs, and five-year reviews. The cost associated with this alternative is summarized below. Additional details on the price breakdown are presented in Appendix C.

Cost Component	Present Value (PV) Cost
Capital Cost	$368,759
O&M Costs	$92,461
Periodic Annual Costs	$23,307
Total PV Cost of Alternative[1]	$485,000

[1] Rounded to the nearest $1,000

4.3 Alternative S-3 – Containment with Land Use Controls

4.3.1 Detailed Description

Under this alternative, an asphalt cover would be placed over soil in excess of the Industrial PRGs (including RIDEM GA Leachability Criterion) at DU 3-2 and 3-3. The cover would also cover soils exceeding the Ecological PRG at DU 3-3. LUCs would be applied to DU 3-1, 3-2, and 3-3 preventing residential use, to DU 3-1 to prevent access to subsurface soil exceeding the Industrial PRG for arsenic, and to DU 3-3 to include maintenance of the ECH building foundation. Regular site inspections of the cover would also be performed to verify its integrity in the long-term.

At DU 3-2, one soil boring location (TF3-020-SB107-0204) exceeded the Industrial PRGs. The RIDEM GA Leachability Criteria served as the basis of the Industrial PRG for naphthalene. Estimated areas and volumes are summarized in Section 2.4.

At DU 3-3, one soil boring location (TF3-ECH-SS108-0001 and TF3-ECH-SB108-0204) exceeded the PRG for PCBs. PCB concentrations exceeded the Industrial and Ecological PRGs in the surface soil sample (TF3-ECH-SS108-0001). In the subsurface soil sample (TF3-ECH-SB108-0204), PCB concentrations exceeded the Ecological PRG. Estimated areas and volumes are summarized in Section 2.4. Details of each component of Alternative S-3 are discussed below.

TPH is not a CERCLA-regulated contaminant and therefore no PRGs were developed in this FS; however, at locations where TPH exceedances are co-located with CERCLA PRG exceedances, the CERCLA response action will address TPH as well. At DU 3-1, this alternative includes LUCs only at DU 3-1 to meet the Residential and Industrial PRGs; however, LUCs would not address the residual TPH concentrations above the RIDEM GA leachability criterion. Rather, the Navy will address the residual TPH under the RIDEM UST and remediation regulations. At DU 3-3, this alternative includes an asphalt cover over soils exceeding the Industrial and Ecological PRGs and it is expected that this action will also address the co-located TPH to meet RIDEM criteria.

<u>Soil Sampling</u> – Prior to the remedial design, sampling will be needed to delineate the extent of soils that exceed PRGs at DU 3-1, 3-2, and 3-3. Sampling to delineate TPH concentrations will be performed under the RIDEM UST and remediation regulations.

At DU 3-1, soil borings with surface and subsurface soil sampling for dioxins, PAHs, arsenic, and manganese would be conducted in order to delineate contamination that exceeds PRGs. In addition to those samples, several of the previous surface soil sample locations where chromium exceedances were observed will be resampled for hexavalent chromium. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil around DU 3-1 are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC. Pre-design soil sampling would also include re-sampling of two 2004 SIRAR subsurface soil locations with elevated TPH and analysis would include the following parameters: VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO). The locations were intended to be re-sampled during the DGA, but it appears that the actual DGA samples were not collected sufficiently close to the historic locations. The results will be compared to the DU 3-1 PRGs and to RIDEM criteria.

At DU 3-2, soil borings with surface and subsurface soil sampling for PCBs would be conducted at a small number of locations to better delineate the extent of surface soil that exceeds the Residential PRG for PCBs. Additionally, test pitting will be performed to identify the extent of oil-soaked wood that was previously observed in the subsurface at TF3-020-SB102B and TF3-020-SB107. The test pit observations would be used to guide further soil sampling for PAHs to delineate exceedances of Residential and Industrial PRGs.

At DU 3-3, soil borings with surface and subsurface soil sampling for PCBs (and lead at select locations) would be conducted to better delineate the extent of soil impacts above Residential, Industrial, and Ecological PRGs. In addition to those samples, several of the previous surface soil sample locations where chromium exceedances were observed will be resampled for hexavalent chromium. Hexavalent chromium is currently identified as a potential COC based on an assumption that the chromium detections in soil around DU 3-1 are hexavalent chromium; however, if hexavalent chromium is determined not to be present, then it would no longer be a COC.

<u>Asphalt Cover</u> – After the extent of Industrial and Ecological PRG exceedances have been delineated, an asphalt cover will be placed over all soils that exceed the Industrial PRGs at DU 3-2 and 3-3 and Ecological PRG at DU 3-3. Further sampling will be performed to refine the areas required to be covered.

An estimate of the impacted areas at DU 3-2 and 3-3 is provided in Section 2.4. The size of the cover will be determined based on the results of the further sampling. The areas currently targeted for the asphalt cover are presented on Figures 12 and 15. The estimated areas are provided below.

Exposure Area	Area of Proposed Asphalt Cap (sq. feet)
DU 3-2	175
DU 3-3	150

The asphalt cover system will consist of 4 inches of asphalt pavement overlying at least 6 inches of clean sub-base material to prevent direct contact, erosion, and transport of remaining soil exceeding Industrial PRGs and Ecological PRGs (DU 3-3 only). The cover will be designed to not interfere with access to the structures. This containment system would also minimize the leaching of PAHs and PCBs from soil to groundwater. Alternate covers are possible, such as those using geomembrane materials; however, the asphalt cover system is a common approach and was used here for costing/comparison purposes.

LUCs and Inspections – LUCs would be applied to DU 3-2 and 3-3 that would restrict cover disturbance and require maintenance of the asphalt covers, as well as perform associated inspections and reporting. LUCs, to include maintenance of the ECH building foundation, would also be required at DU 3-3 to prevent access to soil below the building, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the soil beneath the building would be assessed and remediated, if necessary, to meet Industrial and Ecological PRGs. If and when the ECH building is demolished, the demolition/disposal will meet TSCA protectiveness standards so as not to create a threat of release to the environment. Demolition of this building is not considered part of the remedy. LUCs would also be applied to DU 3-1, 3-2, and 3-3 that prevent residential and unrestricted recreational use so that contact with COCs at concentrations that would cause an unacceptable risk to human receptors is prevented for the life of the remedy.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. Periodic inspections would also be needed to ensure no change in land use and that the surface soil remains undisturbed in the area where arsenic exceeds the Industrial PRG in the surface soil.

The areas currently targeted for LUCs are presented on Figures 9, 12, and 15. The estimated areas are provided below based on currently available data. These areas will be further refined during the pre-design sampling.

Exposure Area	Area of Proposed LUCs (sq. feet)
DU 3-1	4200
DU 3-2	415
DU 3-3	2070

To implement LUCs, the Navy would prepare a LUC RD that would document the LUCs, O&M requirements, inspection requirements, and organizations responsible for implementation of the LUCs. Requirements for management of excavated soil as part of any future construction activities (including sampling and disposal of contaminated soils) at DU 3-1, 3-2, and 3-3 would also be included as part of the LUCs.

The LUC implementation actions including enforcement requirements will be provided in a LUC RD that will be prepared by the Navy as the LUC component of the overall RD. Regular site inspections will be performed to verify the continued maintenance of LUCs until the cleanup levels have been achieved.

LUCs will be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions, per letter dated January 16, 2004, from Alex A. Beehler, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), and the requirements of the FFA. As long as Navy retains ownership of the property, NAVSTA Newport enforces the LUCs and assures that each LUC is maintained appropriately by tracking it through a centralized tracking system. If the property is transferred from the Navy to another federal owner, upon meeting the requirements for transfers under the site's FFA, Navy would ensure as part of the transfer process that the gaining agency is made aware of the existing controls and would take appropriate action to ensure that such controls remain in place. If the property is ever transferred to non-federal ownership, deed restrictions, meeting state property law standards, would be recorded that would incorporate and land use restrictions. Although the Navy may transfer the procedural LUC responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity. LUCs will be maintained until the concentrations of hazardous substances in the soil are at levels that allow for unrestricted use and exposure.

Five-Year Reviews – Contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure, therefore, five-year reviews would be required under this alternative to evaluate the continued adequacy of the remedy. The five-year reviews would be performed as part of the facility-wide five year reviews.

4.3.2 Criteria Analysis

A detailed discussion of the specific attributes of each FS Criteria is presented below and summarized in Table 4-3.

Overall protection of human health and the environment: Alternative S-3 would be protective of human health and the environment. The Containment with Land Use Controls alternative prevents direct contact, erosion, and transport of soil exceeding Industrial PRGs (including RIDEM GA Leachability Criteria) at DU 3-2 and 3-3 and Ecological PRGs at DU 3-3. This containment system would also minimize the leaching of PAHs and PCBs from soil to groundwater. LUCs would be applied to DU 3-2 and 3-3 that restrict cover disturbance and require maintenance of the asphalt covers as well as perform associated inspections and reporting. LUCs would also prevent access to subsurface soil at the portion of DU 3-1 with the Industrial PRG exceedance as well as soil beneath the ECH building at DU 3-3, since the soil beneath the building has not been assessed. LUCs would also be applied to DU 3-1, 3-2, and 3-3 preventing residential use so that contact with COCs at concentrations that would cause an unacceptable risk to human receptors is prevented for the life of the remedy.

Compliance with ARARs: Tables B-3a, B-3b, and B-3c in Appendix B present an evaluation of chemical-specific, location-specific, and action-specific ARARs and TBCs associated with Alternative S-3. With proper execution of this remedy, all chemical-specific ARARs and TBCs will be met and location-specific and action-specific ARARs and TBCs would be complied with.

Long-term effectiveness and permanence: Alternative S-3 would provide permanent long-term protectiveness. By covering the soil concentrations that exceed the Ecological PRGs and Industrial PRGs (including RIDEM GA Leachability Criteria) at DU 3-2 and 3-3, this alternative is effective at reducing direct contact, erosion, and transport of soil. This containment system would also prevent the leaching of PAHs and PCBs from soil to groundwater. In order to ensure the integrity of the cover, LUCs, consisting of cover maintenance, and inspections, would be implemented.

DU 3-1, 3-2, and 3-3 would be suitable for continued use similar to the current use, and LUCs would restrict residential use, under scenarios that could pose unacceptable exposure. Five-year reviews would be conducted to evaluate the continued adequacy of the remedy. The installation of an asphalt cover would impact the ecological habitat. However, this impact would only affect a small area.

Reduction of toxicity, mobility or volume through treatment: This alternative does not involve/ include treatment.

Short-term effectiveness: Alternative S-3 would be effective in the short term as long as work is done properly, with the necessary controls in place. Risks to the community would be minor with the implementation of this alternative. During installation of the cover and environmental monitoring, short-term risks to workers would be mitigated through use of proper PPE. Additionally, impacts to the ecological habitat would occur as part of this alternative.

Implementability: Initial implementation of Alternatives S-3 is not complicated given the site conditions and low concentrations of contaminants, based on the currently assumed extents. Installation of an asphalt cover and LUCs are proven technologies used to address soil contamination at a site. The resources required for implementation of this alternative are readily available.

With the proper planning and design, Alternative S-3 will be relatively easy to implement. Prior to implementing this alternative, a work plan would be prepared to include the specifications of the sampling approach, cover design, and site restoration. The cover will be designed to not interfere with access to the structures. The work plan would also address the necessary health and safety requirements during the field work. Lastly, the preparation and implementation of a LUC RD would require administrative processes that can be easily implemented.

If further action is deemed necessary in the future, the asphalt cover would have to be removed in order to allow for additional remedial actions.

Cost: As part of this alternative, costs are associated with installation of the asphalt cover, environmental sampling, implementation of LUCs, and five-year reviews. The cost associated with this alternative is presented below. Additional details on the price breakdown are presented in Appendix C.

Cost Component	Present Value (PV) Cost
Capital Cost	$369,709
O&M Costs	$105,670
Periodic Annual Costs	$23,307
Total PV Cost of Alternative[1]	$499,000

[1] Rounded to the nearest $1,000

5.0 COMPARATIVE ANALYSIS AND COST SENSITIVITY ANALYSIS OF SOIL ALTERNATIVES

In the sections that follow, a comparative analysis of each alternative is presented along with a cost sensitivity analysis.

5.1 Comparative Analysis

This comparative analysis evaluates the relative performance of each of the candidate alternatives, using the individual detailed evaluation of the specific criteria presented in Section 4.0. To organize the comparative process, the evaluation criteria are grouped into the following categories, which are sorted by the order of importance specified in CERCLA RI/FS guidance:

- Threshold criteria
- Primary balancing criteria
- Modifying criteria

Threshold criteria, according to the NCP, must be achieved by the selected site remedy. The two evaluation factors that are considered to be threshold criteria are listed below. If these criteria not achieved by a particular remedy, then that remedy does not satisfy the minimum expectations for CERCLA response actions.

- Overall protection of human health and the environment
- Compliance with ARARs

Primary balancing criteria are used to weigh the pros and cons of remedies that already satisfy threshold criteria. Specifically, these criteria are used to provide an assessment of the permanence of each remedial alternative, while ensuring their implementability and cost-effectiveness. Further, these criteria encourage the use of treatment technologies that reduce the toxicity, mobility, and volume of contaminants rather than technologies that solely prevent exposure. Primary balancing criteria consist of the following five NCP evaluation criteria:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume of contaminants through treatment
- Short-term effectiveness

- Implementability
- Cost

The final category, *modifying criteria*, are not included in FS evaluations, but are essential in stakeholder discussions and selection of an ultimate site response. This final category of NCP criteria are listed below, but are not included in this FS evaluation, per CERCLA guidance (USEPA, 1988).

- State acceptance
- Community acceptance

Upon finalization of this FS Report, the Navy, RIDEM and other stakeholders will use this FS Report as a reference tool, and will consider the input and expectations of the community in recommending a remedial alternative for implementation. The selected remedy will then be presented to a broader audience in the form of a Proposed Plan, for formal community discussion and comment. Upon stakeholder concurrence on an appropriate site response, the Navy will prepare a ROD to document the selected remedy, and will proceed with contracting the RD and implementation phases of work, as necessary based on the selected remedy.

5.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment, within the limits of the RAOs defined for this FS, is a key threshold criterion that must be attained by an alternative to be eligible for selection in the ROD.

Alternative S-2 is considered the most effective at protecting human health and the environment. Both Alternatives S-2 and S-3 require the implementation of LUCs at DU 3-1, 3-2, and 3-3, which adds protection for human health. Alternative S-2 removes soil that exceeds the Industrial PRGs (including the RIDEM GA Leachability Criteria) and Ecological PRGs (applicable to DU 3-3 only) at DU 3-2 and 3-3. Alternative S-3 includes a physical barrier that would isolate the soil exceeding the Industrial PRGs (including the RIDEM GA Leachability Criteria) and Ecological PRGs (applicable to DU 3-3 only); however, soil concentrations exceeding Industrial and Ecological PRGs would remain at DU 3-2 and 3-3. Both Alternatives S-2 and S-3 rely upon LUCs at DU 3-3 to require maintenance of the ECH building foundation, since the soil beneath the building has not been assessed. As such, Alternative S-2 provides a slightly greater level of protection. Alternative S-1 would not be protective of human health because contact with contaminated soil would not be prevented.

5.1.2 Compliance with ARARs

Appendix B presents the ARARs for the three alternatives. Alternatives S-2 and S-3 meet the chemical-specific, action-specific, and location-specific ARARs. Alternative S-1 does not comply with ARARs since it does not prevent exposure to contaminated soil exceeding the PRGs.

5.1.3 Long-Term Effectiveness and Permanence

In terms of mitigating risks remaining at the site after RAOs have been met, and for risks from management of residuals, Alternative S-2 has the highest long-term effectiveness because much of the more highly contaminated soil would be removed from the site and placed in an appropriately-regulated landfill. Alternatives S-2 and S-3 utilize LUCs to prevent exposure to contaminated soil over the long-term to provide the desired long-term effectiveness. A future residential land use scenario would be prevented under Alternatives S-2 and S-3 and the building foundation at DU 3-3 would need to be maintained; however, controls and inspections would be relied upon to provide permanent protection from contaminants. Alternative S-2 removes soil exceeding the Industrial PRGs (including the RIDEM GA Leachability Criteria) and Ecological PRGs (applicable to DU 3-3 only) at DU 3-2 and 3-3. Alternative S-3, which includes a physical barrier that would isolate the soil, requires additional LUCs to restrict cover disturbance and require maintenance of the asphalt cover. As such, Alternative S-2 provides a slightly greater level of long-term effectiveness and permanence. Alternative S-1 is not effective and doesn't provide permanent protection from contaminants.

5.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The alternatives evaluated do not utilize treatment processes. Therefore, the criteria for treatment have not been evaluated.

5.1.5 Short-Term Effectiveness

The effectiveness of the remedial alternatives during construction and implementation are compared to one another in the following paragraphs.

Protection of Community and Workers During Remedial Action: Short-term risks include any additional risks to the community or workers at the site from exposures to COCs as a result of construction measures and implementation of remedial activities. Since no construction activities or remedial actions are proposed under Alternative S-1, there are no additional short-term risks to the community or workers. Under Alternative S-2, limited excavation is proposed and short-term risks to the workers and surrounding community will be minimal. As part of Alternative S-3, short-term risks to workers will be minimal during the installation of the cover. Alternative S-2 would create more short-term risk to workers than Alternative S-3 since active handling of the contaminated soil creates more dust and contact exposure. Under Alternatives S-2 and S-3, short-term risks to the community would be associated with transportation of contaminated soil over public roads. The short-term risks associated with Alternatives S-2 and S-3 can be mitigated with the use of appropriate PPE during construction activities and proper handling and management (i.e., engineering controls and contingency measures) of contaminated soil.

Environmental Impacts: The remedial alternatives evaluated differ in the magnitude of potential impacts to natural habitats. Since no construction activities or remedial actions are proposed under Alternative S-1, there are no additional short-term impacts to natural habitats. Both Alternatives S-2 and S-3 have the longest construction period and impact the same construction footprint. However, Alternative S-3 has a greater impact to ecological receptors since it eliminates natural habitat in the area of the asphalt cover.

Based on the discussions above, Alternative S-1 is considered the most effective in the short-term, followed by Alternatives S-2 and S-3. Given the small size of DU 3-1, 3-2, and 3-3, short-term risks are not considered significant under any of the remedial alternatives discussed in this FS.

5.1.6 Implementability

The alternatives with the highest degree of implementability would have the following characteristics from USEPA's FS guidance (USEPA, 1988):

- Require the lowest effort to construct, operate and maintain the technologies
- Include or consist only of the highest or most reliable technologies
- Require the lowest effort to undertake additional remedial actions, if necessary
- Include the fewest administrative hurdles for obtaining necessary permits, approvals and agreements
- Rely only minimally on off-site treatment, storage, and disposal facility (TSDF) services
- Require the least amount or quantity of necessary specialized equipment and/or personnel specialists
- Utilize commonly available technologies to the largest degree

Conversely, alternatives with lesser degrees of implementability will have lesser degrees of the characteristics discussed above. The first three bullets define the "technical feasibility" with regard to implementability of the alternative, the fourth bullet defines "administrative feasibility," and the remaining three bullets define the "availability of services and materials" with respect to the alternative. These three factors combine to provide the overall degree of implementability of the alternative.

In general, more complex remedial technologies are more difficult to implement and will have lesser degrees of overall implementability compared to other, less complex, alternatives. As a result, the No Action alternative (S-1) is typically considered the most implementable, and any additional alternatives are less implementable. However, it should be noted that none of the alternatives presented, when applied to these areas, are considered highly complex and are commonly implemented at similar environmental restoration sites.

The following paragraphs present more detailed evaluations of the comparison on implementability characteristics of the remedial alternatives discussed in this FS.

Technical Feasibility: Implementability with regard to the technical feasibility of an alternative includes an evaluation of three factors: 1) ability to construct, operate and maintain the technologies, 2) the reliability of the technologies, and 3) the ease of undertaking additional remedial actions, if warranted by site conditions determined after implementation of the remedy.

Initial implementation of Alternatives S-2 and S-3 is not complicated given the site conditions and low concentrations of contaminants, based on the currently assumed extents. Alternatives S-2 and S-3 are relatively easy to implement because excavation and asphalt covers are common technologies with limited complications. Both Alternatives S-2 and S-3 require implementation of LUCs that prevent residential use. However, Alternative S-3 also requires LUCs that restrict cover disturbance and require maintenance of the asphalt covers as well as perform associated inspections and reporting.

The ease of undertaking additional remedial actions, if warranted by future site conditions or requirements, is proportional to the degree or intensity of each remedy. Since Alternative S-2 would remove all contamination exceeding Industrial PRGs, additional remedial actions can be performed with relative ease. Additional remedial actions would be more difficult to implement for Alternative S-3 since soil exceeding Industrial PRGs remains in place and the asphalt covers may need to be removed to conduct additional remedial actions.

Administrative Feasibility: Alternatives S-2 and S-3 would require administrative issues associated with five-year reviews and LUCs, which are also easily administered. Due to the LUCs associated with the asphalt cover, administrative issues for Alternative S-3 would be more difficult to implement than Alternative S-2. Alternative S-1 would not be administratively feasible since it does not reduce risk at the site and does not satisfy the ARARs.

Availability of Services and Materials: Implementability with regard to the availability of services and materials includes an evaluation of three factors: 1) availability or usage of off-site TSDFs, 2) availability of necessary or specialized equipment or specialist personnel needed to implement the alternative, and 3) availability of prospective technologies required by the alternative. Each of these three factors is described for the alternatives.

Alternative S-1 would not require specialized equipment or personnel. Alternative S-2 would require off-site disposal of soil. Alternative S-3 does not require off-site disposal of soil. All services and materials required for the remaining alternatives would be relatively easy to obtain. Finally, special technologies (i.e., proprietary technologies or technologies with more variables affecting ultimate effectiveness) are not proposed for any of the alternatives discussed in this FS.

Based on the evaluations above, Alternative S-1 is considered the most implementable, followed by Alternatives S-2 and S-3. Given the small sizes of the assumed area of DU 3-1, 3-2, and 3-3, all remedial alternatives discussed in this FS can be implemented with relative ease.

5.1.7 Cost

The costs associated with the three alternatives are summarized in Appendix C. Alternative S-1 is considered the least expensive, followed by Alternatives S-2 and S-3.

Cost Component	Alternative S-1	Alternative S-2	Alternative S-3
Capital Costs	$0	$368,759	$369,709
O&M	$0	$92,461	$105,670
Five-Year Reviews	$0	$23,307	$23,307
Total Cost[1]	$0	$485,000	$499,000

[1] Rounded to the nearest $1,000

5.2 Cost Sensitivity Analysis

There are uncertainties associated with quantitative estimates for each of the remedial alternatives. Each of these uncertainties can have an effect on the resulting estimated costs. Through the preparation of this FS, the most significant uncertainties for DU 3-1, 3-2, and 3-3 include, but are not limited to, the following items:

- Sizes of remediation areas
- Locations of residual contamination
- Samples required to delineate contamination

- Estimate of contingency costs
- Estimate of O&M and five-year review costs

Varying the estimates for these specific cost elements can provide an indication of how the resulting costs of remedial alternatives could potentially change. Using the cost spreadsheets provided in Appendix C, the following two factors have been selected to estimate their impact in *reducing* potential costs:

- Eliminate contingency costs
- Apply a reduction to O&M and Five-Year Review costs

Based on an evaluation of the cost spreadsheets provided in Appendix C, the following three factors have been selected to quantify their impact in *increasing* potential costs:

- Increase area and volume of soil excavation and quantities of imported fill (applicable to Alternative S-2)
- Increase area of asphalt cover and quantities of imported fill and asphalt (applicable to Alternative S-3)
- Increase cost of annual LUC inspections and five-year reviews
- Increase quantities of delineation samples and analyses; quantities of waste characterization samples (applicable to Alternatives S-2); and data validation hours.

Table 5-1 presents the resulting cost impacts if these items are altered. Table 5-1 also includes details on the specific quantities and costs that were adjusted for this cost sensitivity analysis. The comparison provided in Table 5-1 reveals a general trend when particular cost variables are adjusted. However, the overall cost impact resulting from these changes does not impact the comparative analysis of alternatives costs. For example, the upper-end cost estimate for Alternative S-3 is greater than the upper-end cost estimate for Alternative S-2. In summary, if the area or volume of contaminated soil varies during remedial design or remedy implementation, it would not have an impact on the cost component of the comparative analysis presented in this FS. Similarly for the other factors assessed, variations during design or implementation would not be expected to alter the cost component of the comparative analysis.

6.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), 1998. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. December 1998.

Department of Defense (DoD). 2003. The Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions. 2003.

Foster Wheeler Environmental Corporation (FWEC), 2002. Work Plan for Site Closure, Tank Farm 3 Defense Fuel Support Point – Melville, Portsmouth, Rhode Island.

GZA GeoEnvironmental, Inc. (GZA), 1995. Environmental Site Investigation – Tank Farm 3 Defense Fuel Supply Center, Portsmouth, Rhode Island.

GZA, 1996. Supplemental Site Investigation – Tank Farm 3 Defense Fuel Supply Center, Melville, Portsmouth, Rhode Island.

State of Rhode Island and Providence Plantations Department of Environmental Management (RIDEM). 2011. Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases. Amended November 2011.

Tetra Tech EC, 2006. Draft Site Investigation and Remedial Action report for Tank Farm 3, Defense Fuel Support Point – Melville, Portsmouth, Rhode Island. January 2006.

Tetra Tech, 2008. Basewide Background Study Report for Naval Station Newport, Newport, Rhode Island. July 2008.

Tetra Tech. 2015. Final Data Gaps Assessment Report for Areas of Concern (AOCs) –01, -020, and the Electrical Control House (ECH) Area within Site 11 (Tank Farm 3), NAVSTA Newport, Portsmouth, Rhode Island. November 2015.

United States Environmental Protection Agency (USEPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final,* Office of Solid Waste and Emergency Response, Washington, D.C., EPA/540/G-89/004, OSWER Directive 9355.3-01, October 1988.

United States Environmental Protection Agency (USEPA). 1990. National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan; NCP). Code of Federal Regulations, Title 40, Part 300, Federal Register, Volume 55, Number 46, pp. 8666 et seq. March 9, 1990.

United States Environmental Protection Agency (USEPA). 1990. Guidance on Remedial Actions for Superfund Sites with PCB Contamination. OSWER Directive 9355.4-01. August 1990.

United States Environmental Protection Agency (USEPA). 1991. Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals), Interim. EPA/540/R-92/003. Publication 9285.7-01B. December 1991.

United States Environmental Protection Agency (USEPA). 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6, 2014. Updated February 2015.

Van den Berg, M., L. Birnbaum, M. Denison, M. De Vito, W. Farland, M. Feeley, H. Fiedler, H. Hakansson, A. Hanberg, L. Haws, M. Rose, S. Safe, D. Schrenk, C. Tohyama, A. Tritscher, J. Tuomisto, M. Tysklind, N. Walker, and R. E. Peterson (Van den Berg, et al), 2006. The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds ToxSci Advance Access. July 7, 2006.

Tables

Table 2-1a
Chemical-Specific ARARs And TBCs

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	CSFs are estimates of the upper-bound probability of an individual developing cancer as a result of a lifetime exposure to a particular concentration of a potential carcinogen.	Used to compute the potential carcinogenic risks caused by exposure to contaminants in site media.
EPA Risk Reference Doses (RfDs)	None	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants in side media.
Guidelines for Carcinogenic Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	These guidelines provide guidance on conducting risk assessments involving carcinogens.	Used to calculate potential carcinogenic risks caused by exposure to contaminants in site media.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F(March 2005)	To Be Considered	This provides guidance on assessing risk to children from carcinogens.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants in site media.
EPA Guidance on Remedial Actions for Superfund Sites with PCB Contamination	EPA/540/G-90/007 (August 1990)	To Be Considered	This guidance provided preliminary remediation goals (PRGs) for PCBs for various media.	Used in the development of the PRG for soil at DU 3-2 and 3-2 to be protective of unrestricted use by humans and ecological receptors.
Recommendations of the Technical Review Workgroup for Lead for an approach to Assessing Risks Associated with Adult Exposure to Lead In Soil	EPA-540-R-03-001 (January 2003)	To Be Considered	EPA guidance for evaluating risks posed by lead in soil.	Used to calculate potential risks caused by exposure to lead in soil.
Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds.	EPA/600/R-10/005	To Be Considered	EPA guidance for evaluating risks posed by dioxin.	Used to calculate potential risks caused by exposure to dioxin in soil.

Table 2-1a
Chemical-Specific ARARs And TBCs

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments	EPA/540/R-97/006	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs
Final Guidelines for Ecological Risk Assessment	EPA/630/R095/002F	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs
Guidance for Developing Ecological Soil Screening Levels	OSWER Directive 9285.7-55	To Be Considered	EPA guidance for generating ecological soil screening levels	Used to calculate potential wildlife risks and PRGs
Toxicological Benchmarks for Wildlife: 1996 Revision	ES/ER/TM-86/R3	To Be Considered	Oak Ridge National Laboratory guidance on toxicity values for wildlife	Used to calculate potential wildlife risks and PRGs
Wildlife Exposure Factors Handbook. Vols. I and II	EPA/600-R/R-93/187a	To Be Considered	EPA guidance on identifying exposure parameters for wildlife	Used to calculate potential wildlife risks and PRGs
Development and Validation of Bioaccumulation Models for Earthworms	ES/ER/TM-220	To Be Considered	Oak Ridge National Laboratory guidance on uptake of contaminants from soil to earthworms	Used to calculate potential wildlife risks and PRGs
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001, DEM-DSR-01-93, Section 8.02 (with the exception of 8.02A(iv)-TPH)	Applicable	These regulations set direct contact and leachability remediation standards for soil. These standards are applicable to a CERCLA remedy when they are more stringent than federal standards.	These criteria were considered in the development of PRGs for soil based on different land uses.

Table 2-1b
Location-Specific ARARs And TBCs

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Coastal Zone Management Act	Coastal Zone Management Act, 16 USC 1451 *et. seq.*	Applicable	Requires that any actions must be conducted in a manner consistent with state-approved management programs.	A small portion of the site, including DU 3-1, appears to be located within a coastal zone management area; therefore, applicable coastal zone management requirements will be met as needed during the remedial action.
Federal Endangered Species Act of 1973 (ESA); Endangered and Threatened Wildlife and Plants, Special Rules: Northern Long-Eared Bat	16 U.S.C. 1531 et seq.; 50 C.F.R § 17.40(o)	Applicable	The purpose of the ESA is to "conserve the ecosystems upon with threatened and endangered species depend" and to conserve and recover listed species. Federal agencies must consult with the U.S. Fish and Wildlife Service to ensure that the actions they authorize, fund, or carry out will not jeopardize listed species. The Northern Long-Eared Bat (NLEB) is listed as federally threatened. The NLEB range includes Coastal New England towns, such as Portsmouth, RI.	As part of pre-design investigations, Building 227 will be assessed to determine if it is potential bat overwintering habitat. If federally protected bats are located, the U.S. Fish and Wildlife Service will be consulted with during the planning process so that investigations and remedial actions do not adversely impact bat populations or habitat.
State				
Coastal Resources Management	RIGL 46-23-1 *et seq.*	Applicable	Sets standards for management and protection of coastal resources.	A small portion of the site, including DU 3-1, appears to be located within a coastal resource management area; therefore, applicable coastal zone resource management requirements (e.g., soil actions within 200 feet of coastal features) will be met as needed for the remedy.

Table 2-2
Preliminary Remediation Goals (PRGs) for Soil

Analyte	Surface Soil Selected PRG (mg/kg)	Surface Soil Basis[1]	Subsurface Soil Selected PRG (mg/kg)	Subsurface Soil Basis[1]	Decision Unit Applicability[2] DU 3-1	DU 3-2	DU 3-3
Human Health - Residential Use Scenario[3]							
Benzo(a)anthracene	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
Benzo(a)pyrene	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	X	X	
Benzo(b)fluoranthene	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
Chrysene	0.4	RDEC	0.4	RDEC		X	
Dibenzo(a,h)anthracene	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	X	X	
Indeno(1,2,3-cd)pyrene	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
Naphthalene	0.8	Leachability	0.8	Leachability	X	X	
2,3,7,8-TCDD Equivalents	0.0000048	ILCR = 10^{-6}	0.0000048	ILCR = 10^{-6}	X		
PCBs	1	TSCA	1	TSCA		X	X
Arsenic	17	Background	7	RDEC	X		X
Chromium VI[4]	0.31	ILCR = 10^{-6}	0.31	ILCR = 10^{-6}	X		X
Lead	150	RDEC	150	RDEC			X
Manganese	390	RDEC	460	Background	X		X
Human Health - Industrial Use Scenario							
Benzo(a)pyrene	0.8	I/C DEC	0.8	I/C DEC		X	
Naphthalene	0.8	Leachability	0.8	Leachability		X	
PCBs	10	I/C DEC, Leachability	10	I/C DEC, Leachability			X
Arsenic	17	Background	7	I/C DEC	X		
Ecological							
PCBs	3.6	Ecological	3.6	Ecological			X

Notes
1. See Appendix A.1 and A.2 for Human Health and Ecological PRG development and basis:
   ILCR = 10^{-6} - Carcinogenic risk-based goal developed from the human health risk assessment
   RDEC and I/C DEC - RIDEM Remediation Regulations, DEM-DSR-01-93, November 2011, Table 1 (Residential and Industrial/Commercial Direct Exposure Criteria [DEC])
   Leachability - RIDEM Remediation Regulations, DEM-DSR-01-93, November 2011, Table 2 (GA Leachability Criteria)
   TSCA - Toxic Substances Control Act; Section 761.61(c) of TSCA (see Appendix B for full citation) allows for risk-based cleanup of PCB remediation waste. EPA guidance on Remedial Actions at Superfund Sites with PCB Contamination (OSWER Directive #9355.4-01FS; EPA/540/G-90/007; August 1990) was utilized to develop the risk-based value presented. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.
   Background - If RIDEM criteria or risk-based PRGs were below reference concentrations for the site, the background concentration was selected.
2. While the human health risk assessment evaluated all three AOCs together, the various analytes were analyzed/detected in specific AOCs based on the conceptual site model. The PRGs are applicable to those specific AOCs.
3. Residential use scenario PRGs are reflected for establishing the land use control boundary.
4. Chromium speciation has not been performed for this site. At this time, chromium has been assumed to be hexavalent chromium even though there is no current evidence that it would be this species.

Table 2-3a
Analytical Results - Surface Soil at Decision Unit 3-1

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-001-SB101-0102	TF3-001-SS102-0001	TF3-001-SS103-0001	TF3-001-SS104-0001	TF3-001-SS105-0001	TF3-001-SS106-0001	TF3-001-SS107-0001	TF3-001-SS108-0001	TF3-001-SS109-0001
Location ID			TF3-001-SB101	TF3-001-SB102	TF3-001-SB103	TF3-001-SB104	TF3-001-SB105	TF3-001-SB106	TF3-001-SB107	TF3-001-SB108	TF3-001-SB109
Sample Date			11/22/2013	11/22/2013	11/22/2013	11/21/2013	11/21/2013	11/22/2013	11/22/2013	11/22/2013	11/22/2013
Sample Type			N	N	N	N	N	N	N	N	N
Depth Interval			1 - 2 ft	0 - 1 ft	0 - 1 ft	0 -1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft
Analytical Parameter	Residential PRG	Industrial PRG									
Metals (mg/kg)											
ALUMINUM			13200	13500	12300	12700	12200	12200	10400	11800	14600
ANTIMONY			0.08	0.09 J	0.14 J	0.09 J	0.07 J	0.08	0.08	0.07 J	0.06 J
ARSENIC	17	17	5.6	7.8	6	6.5	7.1	6.4	5.1	5.6	7.2
BARIUM			28.5	19.1	22.5	22.8	19.2	32	16.4	33.5	16.6
BERYLLIUM			0.35	0.32	0.36	0.36	0.34	0.32	0.29	0.3	0.3
CADMIUM			0.08	0.08 J	0.1	0.12	0.1 J	0.08	0.09	0.07 J	0.08
CALCIUM			844	859 J	932 J	642 J	878 J	1180	928	1260	1200 J
CHROMIUM, TOTAL	0.31		16.8	17.8	16.7	15.6	16.8	19.3	17.1	19.6	22.3
COBALT			10.2	11	11.7	12	13	10.8	12	10.5	20.9
COPPER			15.1	17 J	17.1 J	17.8 J	20.2 J	18.5	17.5	15.4	22.8 J
IRON			22500	31900	27000	24200	28000	25600	28200	23000	34500
LEAD			12.8	18.9 J	21.4 J	20.7 J	14.4 J	13.4	16.2	11.4	14.4 J
MAGNESIUM			2750	3260	2980	2730	3160	4270	3320	4230	5280
MANGANESE	390		305	342 J	415 J	414 J	412 J	351	404	314	514 J
MERCURY			0.03	0.03	0.03	0.04	0.04	0.03 J	< 0.02 U	< 0.013 U	< 0.015 U
NICKEL			19.2	22.9	24.7	21.9	23.8	20.1	22.3	19.6	32.5
POTASSIUM			786	394 J	544 J	437 J	385 J	1010	470	1050	472 J
SELENIUM			0.52 J	0.4 J	0.38 J	0.45	0.38 J	0.29 J	0.28 J	0.3 J	0.33 J
SILVER			0.06 J	0.07 J	0.06 J	0.07 J	0.05 J	0.04 J	0.05 J	0.03 J	0.04 J
SODIUM			53.5 J	48.4 J	69.2 J	37.3 J	47.3 J	46.4 J	32.9 J	64.1 J	35.7 J
THALLIUM			0.09	0.08 J	0.07 J	0.08	0.07 J	0.07	0.05 J	0.07 J	0.05 J
VANADIUM			22.4	20.9	27	21.2	20.3	20.9	18.4	24.4	20
ZINC			52.2	94.4	68.3	63.6	60.8	54.7	59.5	48.7	76.8
Dioxin/Furans (ng/kg)											
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN			2.8 J	7.1	5.4 J	6.2 J	4.1 J	1200	1.8 J	500	1.7 J
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN			56	74	62	60	53	7000	44	1900	30
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN			< 0.075 U	< 0.091 U	< 0.11 U	< 0.13 U	0.34 J	100	< 0.053 U	20	< 0.086 U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN			0.76 J	0.85 J	1.3 J	1 J	< 0.51 U	43	< 0.38 U	17	0.5 J
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.66 J	0.81 J	0.74 J	0.69 J	0.74 J	38	0.22 J	30	0.34 J
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN			0.61 J	0.88 J	0.5 J	1 J	0.66 J	49	0.68 J	31	0.39 J
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.95 J	1.4 J	1.4 J	1.2 J	1.5 J	150	0.51 J	68	0.53 J
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN			< 0.054 U	< 0.046 U	< 0.06 U	< 0.069 U	< 0.031 U	< 0.56 U	< 0.042 U	< 0.24 U	< 0.045 U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN			1.1 J	1.9 J	1.8 J	1.3 J	1.6 J	88	0.48 J	70	0.71 J
1,2,3,7,8-PENTACHLORODIBENZOFURAN			0.23 J	0.18 J	0.29 J	0.24 J	< 0.037 U	3.5 J	0.075 J	1.9 J	< 0.045 U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN			< 0.094 U	0.47 J	0.47 J	0.33 J	0.25 J	11	< 0.072 U	10	< 0.091 U
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN			< 0.05 U	0.58 J	0.59 J	0.55 J	0.47 J	28	0.39 J	21	0.1 J
2,3,4,7,8-PENTACHLORODIBENZOFURAN			0.25 J	0.31 J	0.23 J	0.29 J	0.15 J	2.8 J	0.22 J	1.9 J	< 0.047 U
2,3,7,8-TETRACHLORODIBENZOFURAN			< 0.24 U	< 0.44 U	< 0.2 U	0.36 J	< 0.32 U	< 0.43 U	< 0.23 U	< 0.33 U	< 0.26 U
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN			< 0.05 U	< 0.057 U	< 0.05 U	< 0.055 U	< 0.038 U	0.4 J	< 0.042 U	0.51 J	< 0.053 U
HEPTACHLORODIBENZOFURAN			5.3 J	17 J	11 J	16	9.4	4100	4.3 J	960	3.8 J
HEPTACHLORODIBENZO-P-DIOXINS			100	130	120	110	95	9300	76	3100	51
HEXACHLORODIBENZOFURAN			4.6 J	9.1 J	9 J	8.2 J	6.1 J	1100	5.6	560	2.7 J
HEXACHLORODIBENZO-P-DIOXIN			9.5 J	14 J	14 J	12 J	11	850	4.5 J	570	5.4 J
OCTACHLORODIBENZOFURAN			5.2 J	17	11 J	18	7.7 J	4200	3.2 J	590	3.5 J
PENTACHLORODIBENZOFURAN			3.6 J	4.5 J	4.2 J	4 J	2.6 J	160 J	4.6 J	100 J	0.56 J
PENTACHLORODIBENZO-P-DIOXIN			2.1 J	2.6 J	2.4 J	2.5 J	1.5 J	85 J	1.6 J	64 J	0.76 J
TCDF, TOTAL			3.2 J	3.5 J	2.8 J	3.1 J	2.5 J	21	2.8 J	11 J	0.35 J
TEQ	4.8		4.01946	5.0265	3.928	3.8616	3.19871	150.005	3.24521	64.314	2.28505
TETRACHLORODIBENZO-P-DIOXIN			0.7 J	1.2 J	0.94 J	0.79 J	0.84 J	7.1 J	0.68 J	5.1 J	0.16 J
Miscellaneous Parameters (%)											
TOTAL SOLIDS			84	86	86	87	87	88	90	88	89

Table 2-3a
Analytical Results - Surface Soil at Decision Unit 3-1

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-001-SB101-0102	TF3-001-SS102-0001	TF3-001-SS103-0001	TF3-001-SS104-0001	TF3-001-SS105-0001	TF3-001-SS106-0001	TF3-001-SS107-0001	TF3-001-SS108-0001	TF3-001-SS109-0001
Location ID			TF3-001-SB101	TF3-001-SB102	TF3-001-SB103	TF3-001-SB104	TF3-001-SB105	TF3-001-SB106	TF3-001-SB107	TF3-001-SB108	TF3-001-SB109
Sample Date			11/22/2013	11/22/2013	11/22/2013	11/21/2013	11/21/2013	11/22/2013	11/22/2013	11/22/2013	11/22/2013
Sample Type			N	N	N	N	N	N	N	N	N
Depth Interval			1 - 2 ft	0 - 1 ft	0 - 1 ft	0 -1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft
Analytical Parameter	Residential PRG	Industrial PRG									
Semi Volatile Organic Compounds (SVOCs) (mg/kg)											
2-METHYLNAPHTHALENE			< 0.011 UJ	< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 UJ	< 0.01 UJ	< 0.01 UJ	< 0.011 U
ACENAPHTHENE			< 0.011 U	0.0017 J	< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.01 U	< 0.01 U	< 0.011 U
ACENAPHTHYLENE			< 0.011 U	0.0018 J	0.0015 J	0.0017 J	0.0017 J	< 0.011 U	0.0013 J	< 0.01 U	< 0.011 U
ANTHRACENE			< 0.011 U	0.005 J	0.0033 J	0.004 J	0.0031 J	0.0018 J	0.0031 J	< 0.01 U	0.0016 J
BENZO[A]ANTHRACENE	0.16		< 0.0066 U	0.041	0.043 J	0.041	0.038	0.022 J	0.039	< 0.0076 U	0.015 J
BENZO[A]PYRENE	0.016		0.0075 J	0.042	0.048 J	0.05	0.039	0.026 J	0.047 J	0.0079 J	0.014 J
BENZO[B]FLUORANTHENE	0.16		0.012 J	0.064	0.09 J	0.076	0.057	0.04	0.08	0.016 J	0.029 J
BENZO[G,H,I]PERYLENE			< 0.011 UJ	0.019 J	0.023 J	0.024	0.012 J	0.012 J	0.023 J	0.0057 J	0.0075 J
BENZO[K]FLUORANTHENE			0.0064 J	0.035 J	0.025 J	0.029 J	0.028	0.018 J	0.03	0.0057 J	0.0075 J
CHRYSENE			0.0064 J	0.05	0.05 J	0.053	0.042	0.03	0.054	0.0086 J	0.013 J
DIBENZ[A,H]ANTHRACENE	0.016		< 0.011 U	0.0095 J	0.0098 J	0.0095 J	0.0061 J	0.0055 J	0.01 J	0.0029 J	0.0029 J
FLUORANTHENE			0.0093 J	0.075	0.052	0.073	0.04	0.038	0.052	0.012 J	0.02 J
FLUORENE			< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.01 U	< 0.01 U	< 0.011 U
INDENO[1,2,3-CD]PYRENE	0.16		0.0067 J	0.041	0.033 J	0.046	0.027	0.025 J	0.043 J	0.0054 J	0.0097 J
NAPHTHALENE	0.8		< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.011 U	< 0.01 U	< 0.01 U	< 0.011 U
PHENANTHRENE			0.0048 J	0.028	0.023 J	0.024	0.012 J	0.011 J	0.017 J	0.004 J	0.011 J
PYRENE			0.0068 J	0.074	0.1 J	0.072	0.036	0.057	0.067	0.0097 J	0.03 J
TOTAL PAHs			0.0599	0.487	0.5016	0.5032	0.3412	0.2863	0.4664	0.0779	0.1612
Petroleum Hydrocarbons (mg/kg)											
Extractable TPH C8-C44			120	91	320	48	36	140	150	140	91
TPH-GASOLINE RANGE C6-C12			< 2.4 U	< 2.3 U	< 2.5 U	< 2.7 U	< 2.2 U	< 2.9 U	< 2.1 U	< 2.3 U	28
Volatile Organic Compounds (mg/kg)											
1,2,4-TRIMETHYLBENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
1,2-DIBROMOETHANE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
1,3,5-TRIMETHYLBENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
2-BUTANONE			0.012 J	0.017 J	0.026 J	0.03 J	0.03 J	0.007 J	< 0.012 UJ	0.016 J	0.0074 J
2-HEXANONE			< 0.012 UJ	< 0.012 UJ	< 0.014 UJ	< 0.012 UJ	< 0.012 UJ	< 0.011 UJ	< 0.012 UJ	< 0.012 UJ	< 0.014 U
4-ISOPROPYLTOLUENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	0.00097 J	< 0.0028 U
4-METHYL-2-PENTANONE			< 0.012 UJ	< 0.012 UJ	< 0.014 UJ	< 0.012 UJ	< 0.012 UJ	< 0.011 UJ	< 0.012 UJ	< 0.012 UJ	< 0.014 U
ACETONE			< 0.22 TB	< 0.21 TB	< 0.32 TB	< 0.33 TB	< 0.35 TB	< 0.082 TB	< 0.076 TB	< 0.21 TB	< 0.1 TB
BENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
BROMOFORM			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
BROMOMETHANE			< 0.0048 UJ	< 0.005 UJ	< 0.0055 UJ	< 0.005 UJ	< 0.0048 UJ	< 0.0042 UJ	< 0.0048 UJ	< 0.005 UJ	< 0.0055 U
CARBON DISULFIDE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
CYCLOHEXANE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
ETHYLBENZENE			0.00066 J	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
ISOPROPYLBENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
M- AND P-XYLENE			0.0037 J	< 0.005 UJ	< 0.0055 UJ	< 0.005 UJ	< 0.0048 UJ	< 0.0042 UJ	< 0.0048 UJ	< 0.005 UJ	< 0.0055 U
METHYL ACETATE			0.06 J	< 0.003 UJ	< 0.0033 UJ	< 0.003 UJ	< 0.0029 UJ	0.008 J	0.0076 J	0.023 J	< 0.0033 UJ
METHYL CYCLOHEXANE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
METHYL TERT-BUTYL ETHER			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
NAPHTHALENE	0.8		< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
N-BUTYLBENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
O-XYLENE			0.0016 J	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
PROPYLBENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
SEC-BUTYLBENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
STYRENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
TERT-BUTYLBENZENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
TOLUENE			< 0.0024 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.0025 UJ	< 0.0024 UJ	< 0.0021 UJ	< 0.0024 UJ	< 0.0025 UJ	< 0.0028 U
XYLENES, TOTAL			0.0052 J	< 0.0075 UJ	< 0.0082 UJ	< 0.0075 UJ	< 0.0072 UJ	< 0.0064 UJ	< 0.0072 UJ	< 0.0075 UJ	< 0.0082 U

Notes:

1. Red shading indicates Residential PRG exceeded.

2. Blue shading indicates Industrial and Residential PRGs exceeded.

Table 2-3b
Analytical Results - Subsurface Soil at Decision Unit 3-1

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-001-SB101-0204	TF3-001-SB102-0406	TF3-001-SB103-0608-D	TF3-001-SB103-0608	TF3-001-SB104-0204	TF3-001-SB105-0204	TF3-001-SB105-0204-D	TF3-001-SB106-0204	TF3-001-SB107-0204-D
Location ID			TF3-001-SB101	TF3-001-SB102	TF3-001-SB103	TF3-001-SB103	TF3-001-SB104	TF3-001-SB105	TF3-001-SB105	TF3-001-SB106	TF3-001-SB107
Sample Date			11/22/2013	11/22/2013	11/22/2013	11/22/2013	11/21/2013	11/21/2013	11/22/2013	11/22/2013	11/22/2013
Sample Type			N	N	FD	N	N	N	FD	N	FD
Depth Interval			2 - 4 ft	4 - 6 ft	6 - 8 ft	6 - 8 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG									
Metals (mg/kg)											
ALUMINUM			10600	13000	13900	13100	10500	9400		12200	12400
ANTIMONY			0.06 J	0.1 J	0.07 J	0.1 J	0.05 J	0.07 J		0.09	0.07 J
ARSENIC	7	7	4.5	6.1	6.5	7	5.5	5.8		6.6	6.2
BARIUM			20.2	20.9	36	36.6	16	14.4		16.2	12.7
BERYLLIUM			0.34	0.36	0.44	0.43	0.32	0.36		0.38	0.31
CADMIUM			0.07	0.09 J	0.11	0.12	0.07	0.07 J		0.1	0.11
CALCIUM			800	3110 J	3700 J	6420 J	616 J	314 J		573	729
CHROMIUM, TOTAL	0.31		13.3	16.7	16.4	16.9	13.4	12.1		17.4	16.6
COBALT			10	13.2	12.9	16	9.3	10.2		12.4	14.2
COPPER			12.7	14.2 J	12.8 J	14.3 J	11.3 J	13 J		19.2	17
IRON			22500	26900	27800	32000	20000	20000		33900	34800
LEAD			11.7	17.9 J	11.6 J	10.6 J	11.7 J	7.1 J		11.8	15.7
MAGNESIUM			2320	3300	2880	3270	2420	2510		3140	3720
MANGANESE	460		366	383 J	485 J	704 J	271 J	276 J		405	584
MERCURY			0.03 J	0.04	< 0.02 U	< 0.016 U	0.02 J	< 0.018 U		< 0.017 U	< 0.016 U
NICKEL			18.6	23.7	23.3	26.8	16.8	16.9		23.5	27.4
POTASSIUM			443	383 J	590 J	619 J	386 J	408 J		418	273
SELENIUM			0.35 J	0.36 J	0.5	0.36 J	0.27 J	0.24 J		0.4 J	0.32 J
SILVER			0.05 J	0.06 J	0.06 J	0.05 J	0.04 J	0.02 J		0.04 J	0.04 J
SODIUM			40.4 J	49.9 J	66.7 J	87 J	34.2 J	36.6 J		32.3 J	35 J
THALLIUM			0.07	0.07 J	0.09 J	0.08 J	0.07	0.07 J		0.06 J	0.04 J
VANADIUM			19.9	21.6	22.4	23.6	17.8	15.4		21.4	17.3
ZINC			51.7	69.6	83.2	89.8	44.2	44.4		63.6	73.5
Dioxin/Furans (ng/kg)											
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN			2.7 J	7.5		< 0.85 U	1.6 J	< 0.75 U	< 0.95 U	15	3 J
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN			45	66		50	39	99 J	45 J	150	130
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN			< 0.047 U	< 0.097 U		< 0.097 U	< 0.047 U	0.14 J	0.12 J	0.86 J	< 0.045 U
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN			< 0.35 U	2.1 J		0.71 J	0.4 J	< 0.26 U	0.73 J	0.76 J	< 0.41 U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.45 J	0.64 J		0.2 J	0.16 J	0.39 J	0.26 J	0.8 J	0.62 J
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN			0.6 J	0.6 J		0.23 J	0.94 J	0.77 J	0.26 J	1.9 J	2.9 J
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.64 J	1.2 J		0.4 J	0.39 J	0.26 J	0.35 J	1.5 J	1.1 J
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN			< 0.033 U	< 0.045 U		< 0.06 U	< 0.04 U	0.24 J	< 0.036 U	< 0.041 U	0.11 J
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN			0.78 J	1.4 J		0.53 J	0.46 J	0.43 J	0.4 J	1.4 J	1.2 J
1,2,3,7,8-PENTACHLORODIBENZOFURAN			< 0.042 U	0.15 J		< 0.052 U	< 0.046 U	0.13 J	0.071 J	0.21 J	< 0.035 U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN			< 0.068 U	0.33 J		< 0.093 U	< 0.058 U	< 0.064 U	< 0.058 U	< 0.086 U	0.22 J
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN			0.28 J	0.69 J		< 0.054 U	0.25 J	0.18 J	0.24 J	0.62 J	0.21 J
2,3,4,7,8-PENTACHLORODIBENZOFURAN			< 0.043 U	0.39 J		< 0.055 U	< 0.048 U	0.15 J	0.14 J	< 0.047 U	0.12 J
2,3,7,8-TETRACHLORODIBENZOFURAN			< 0.26 U	< 0.16 U		< 0.2 U	< 0.17 U	< 0.3 U	< 0.21 U	< 0.26 U	< 0.33 U
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN			< 0.048 U	< 0.064 U		< 0.057 U	< 0.041 U	< 0.036 U	< 0.046 U	< 0.048 U	< 0.037 U
HEPTACHLORODIBENZOFURAN			4.8 J	13 J		1.5 J	2.7 J	< 1.2 U	1.7 J	36	7.6
HEPTACHLORODIBENZO-P-DIOXINS			79	120		88	67	160 J	77 J	240	210
HEXACHLORODIBENZOFURAN			4.1 J	10 J		2.7 J	3.6 J	1.6 J	3 J	16	7.4
HEXACHLORODIBENZO-P-DIOXIN			6.1	12 J		5.6 J	4 J	2.7 J	4.6 J	12 J	8.1 J
OCTACHLORODIBENZOFURAN			3.4 J	12 J		5 J	2.6 J	< 1.4 U	4.8 J	33	4.9 J
PENTACHLORODIBENZOFURAN			2.2 J	5.4 J		1.5 J	1.7 J	0.28 J	2.7 J	3.3 J	2.9 J
PENTACHLORODIBENZO-P-DIOXIN			1.3 J	2.2 J		1.6 J	1.2 J	3.3 J	1.9 J	3.8 J	4.2 J
TCDF, TOTAL			1.8 J	3.7 J		1.7 J	2 J	0.86 J	2.1 J	1.6 J	2.2 J
TEQ	4.8		3.33302	4.5231		4.9085	3.21678	7.5673	4.32077	10.1728	10.30147
TETRACHLORODIBENZO-P-DIOXIN			0.4 J	0.84 J		0.64 J	1.4 J	1.3 J	0.55 J	1.2 J	0.69 J
Miscellaneous Parameters (%)											
TOTAL SOLIDS			87	78	85	84	88	89		88	89

Table 2-3b
Analytical Results - Subsurface Soil at Decision Unit 3-1

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-001-SB101-0204	TF3-001-SB102-0406	TF3-001-SB103-0608-D	TF3-001-SB103-0608	TF3-001-SB104-0204	TF3-001-SB105-0204	TF3-001-SB105-0204-D	TF3-001-SB106-0204	TF3-001-SB107-0204-D
Location ID			TF3-001-SB101	TF3-001-SB102	TF3-001-SB103	TF3-001-SB103	TF3-001-SB104	TF3-001-SB105	TF3-001-SB105	TF3-001-SB106	TF3-001-SB107
Sample Date			11/22/2013	11/22/2013	11/22/2013	11/22/2013	11/21/2013	11/21/2013	11/22/2013	11/22/2013	11/22/2013
Sample Type			N	N	FD	N	N	N	FD	N	FD
Depth Interval			2 - 4 ft	4 - 6 ft	6 - 8 ft	6 - 8 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG									
Semi Volatile Organic Compounds (SVOCs) (mg/kg)											
2-METHYLNAPHTHALENE			< 0.01 UJ	< 0.013 U	< 0.035 U	< 0.034 U	< 0.011 U	< 0.011 U		< 0.011 UJ	< 0.011 UJ
ACENAPHTHENE			< 0.01 U	0.0066 J	0.063 J	0.072	< 0.011 U	< 0.011 U		0.0059 J	< 0.011 U
ACENAPHTHYLENE			< 0.01 U	< 0.013 U	< 0.035 U	< 0.034 U	< 0.011 U	< 0.011 U		< 0.011 U	< 0.011 U
ANTHRACENE			0.0014 J	0.0078 J	< 0.035 U	< 0.034 U	< 0.011 U	< 0.011 U		0.011 J	< 0.011 U
BENZO[A]ANTHRACENE	0.16		< 0.011 U	0.069 J	< 0.035 U	0.019 J	0.0074 J	< 0.011 U		0.033	< 0.012 U
BENZO[A]PYRENE	0.016		0.011 J	0.074 J	< 0.035 U	0.018 J	0.0076 J	< 0.011 U		0.024 J	0.013 J
BENZO[B]FLUORANTHENE	0.16		0.017 J	0.11	< 0.035 U	0.036 J	0.013 J	< 0.011 U		0.037	0.02 J
BENZO[G,H,I]PERYLENE			0.0023 J	0.028 J	< 0.035 U	0.0098 J	0.0042 J	< 0.011 U		0.0051 J	0.0031 J
BENZO[K]FLUORANTHENE			0.0082 J	0.044	< 0.035 U	0.014 J	0.0059 J	< 0.011 U		0.014 J	0.0089 J
CHRYSENE			0.012 J	0.082 J	< 0.035 U	< 0.034 U	0.0098 J	< 0.011 U		0.038	0.013 J
DIBENZ[A,H]ANTHRACENE	0.016		< 0.01 U	0.012 J	< 0.035 U	< 0.034 U	< 0.011 U	< 0.011 U		0.0048 J	0.0027 J
FLUORANTHENE			0.017 J	0.11 J	0.021 J	0.064 J	0.017 J	< 0.011 U		0.077	0.023
FLUORENE			< 0.01 U	0.0071 J	0.17	0.21	< 0.011 U	< 0.011 U		0.0053 J	< 0.011 U
INDENO[1,2,3-CD]PYRENE	0.16		0.0089 J	0.058 J	< 0.035 U	0.011 J	0.0083 J	< 0.011 U		0.02 J	0.012 J
NAPHTHALENE	0.8		< 0.01 U	< 0.013 U	< 0.035 U	< 0.034 U	< 0.011 U	< 0.011 U		< 0.011 U	< 0.011 U
PHENANTHRENE			0.0081 J	0.067 J	0.33	0.37	0.0083 J	< 0.011 U		0.09	0.011 J
PYRENE			0.018 J	0.15	0.041 J	0.078	0.015 J	< 0.011 U		0.076	0.018 J
TOTAL PAHs			0.1039	0.8255	0.625	0.9018	0.0965	0 U		0.4411	0.1247
Petroleum Hydrocarbons (mg/kg)											
Extractable TPH C8-C44			68	320 J	2200	2500	120 J	< 10 U		17 J	140
TPH-GASOLINE RANGE C6-C12			< 2.3 U	< 4.8 U	81 J	42 J	< 2.1 U	< 2.2 U		< 2.5 U	< 2.2 U
Volatile Organic Compounds (mg/kg)											
1,2,4-TRIMETHYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
1,2-DIBROMOETHANE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
1,3,5-TRIMETHYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
2-BUTANONE			0.0092 J	0.006 J	0.016 J	0.01 J	< 0.01 UJ	0.013 J		0.0084 J	< 0.014 UJ
2-HEXANONE			< 0.018 UJ	< 0.0072 UJ	< 0.012 UJ	< 0.014 UJ	< 0.01 UJ	< 0.012 U		< 0.014 UJ	< 0.014 UJ
4-ISOPROPYLTOLUENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
4-METHYL-2-PENTANONE			< 0.018 UJ	< 0.0072 UJ	< 0.012 UJ	< 0.014 UJ	< 0.01 UJ	< 0.012 U		< 0.014 UJ	< 0.014 UJ
ACETONE			< 0.14 TB	< 0.077 TB	< 0.11 TB	< 0.11 TB	0.076 J	0.14 J		< 0.14 TB	< 0.059 TB
BENZENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
BROMOFORM			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
BROMOMETHANE			< 0.007 UJ	< 0.0029 UJ	< 0.005 UJ	< 0.0055 UJ	< 0.004 UJ	< 0.0046 U		< 0.0055 UJ	< 0.0055 UJ
CARBON DISULFIDE			< 0.0035 UJ	0.0015 J	0.055 J	0.039 J	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
CYCLOHEXANE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
ETHYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
ISOPROPYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	0.0052 J	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
M- AND P-XYLENE			< 0.007 UJ	< 0.0029 UJ	< 0.005 UJ	< 0.0055 UJ	< 0.004 UJ	< 0.0046 U		< 0.0055 UJ	< 0.0055 UJ
METHYL ACETATE			< 0.0042 UJ	< 0.0017 UJ	0.027 J	< 0.0033 UJ	< 0.0024 UJ	< 0.0028 UJ		0.022 J	0.017 J
METHYL CYCLOHEXANE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
METHYL TERT-BUTYL ETHER			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
NAPHTHALENE	0.8		< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
N-BUTYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	0.062 J	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
O-XYLENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
PROPYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
SEC-BUTYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	0.057 J	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
STYRENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
TERT-BUTYLBENZENE			< 0.0035 UJ	< 0.0014 UJ	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
TOLUENE			< 0.0035 UJ	0.0014 J	< 0.0025 UJ	< 0.0028 UJ	< 0.002 UJ	< 0.0023 U		< 0.0028 UJ	< 0.0028 UJ
XYLENES, TOTAL			< 0.01 UJ	< 0.0044 UJ	< 0.0075 UJ	< 0.0082 UJ	< 0.0061 UJ	< 0.0069 U		< 0.0082 UJ	< 0.0082 UJ

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial and Residential PRGs exceeded.

Table 2-3b

Analytical Results - Subsurface Soil at Decision Unit 3-1

Site			SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-001-SB107-0204	TF3-001-SB108-0204	TF3-001-SB109-0406
Location ID			TF3-001-SB107	TF3-001-SB108	TF3-001-SB109
Sample Date			11/22/2013	11/22/2013	11/22/2013
Sample Type			N	N	N
Depth Interval			2 - 4 ft	2 - 4 ft	4 - 6 ft
Analytical Parameter	Residential PRG	Industrial PRG			
Metals (mg/kg)					
ALUMINUM			12300	12600	15500
ANTIMONY			0.08	0.1 J	0.05 J
ARSENIC	7	7	7	6.8	9.8
BARIUM			12.7	17.5	12.9
BERYLLIUM			0.34	0.33	0.26
CADMIUM			0.11	0.09	0.11
CALCIUM			910	814	963 J
CHROMIUM, TOTAL	0.31		18.5	16.6	23.9
COBALT			15.6	13.5	18.3
COPPER			19.3	17.3	18.1 J
IRON			35200	29000	36200
LEAD			13.7	12.7	10.8 J
MAGNESIUM			3710	3320	5330
MANGANESE	460		576	441	495 J
MERCURY			< 0.014 U	< 0.017 U	< 0.012 U
NICKEL			30.2	26.2	35.7
POTASSIUM			265	376	326 J
SELENIUM			0.39 J	0.41 J	0.27 J
SILVER			0.04 J	0.04 J	0.03 J
SODIUM			27.7 J	42.2 J	37.6 J
THALLIUM			0.04 J	0.06 J	0.04 J
VANADIUM			19.4	18.8	19.4
ZINC			87	63.8	88.5
Dioxin/Furans (ng/kg)					
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN			3.1 J	18	41
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN			140	120	23
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN			< 0.065 U	0.87 J	1.2 J
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN			< 0.23 U	0.85 J	15
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.68 J	1.4 J	0.22 J
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN			1.2 J	2 J	1.9 J
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN			1.1 J	2.9 J	0.27 J
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN			< 0.064 U	< 0.039 U	< 0.05 U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN			1.3 J	3.1 J	0.36 J
1,2,3,7,8-PENTACHLORODIBENZOFURAN			0.12 J	< 0.037 U	0.32 J
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN			0.24 J	0.53 J	< 0.07 U
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN			0.45 J	0.83 J	0.58 J
2,3,4,7,8-PENTACHLORODIBENZOFURAN			0.16 J	0.12 J	1 J
2,3,7,8-TETRACHLORODIBENZOFURAN			< 0.31 U	< 0.24 U	< 0.2 U
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN			< 0.056 U	< 0.03 U	< 0.097 U
HEPTACHLORODIBENZOFURAN			7.9	36	46 J
HEPTACHLORODIBENZO-P-DIOXINS			230	200	38
HEXACHLORODIBENZOFURAN			6.3 J	22	25
HEXACHLORODIBENZO-P-DIOXIN			9.2 J	24 J	3.1 J
OCTACHLORODIBENZOFURAN			5.9 J	23	74
PENTACHLORODIBENZOFURAN			3.6 J	5 J	8.7 J
PENTACHLORODIBENZO-P-DIOXIN			5.1 J	4 J	1.6 J
TCDF, TOTAL			2.4 J	2 J	4.1 J
TEQ	4.8		11.19737	6.3696	4.1668
TETRACHLORODIBENZO-P-DIOXIN			0.69 J	0.87 J	0.75 J
Miscellaneous Parameters (%)					
TOTAL SOLIDS			89	88	88

Table 2-3b
Analytical Results - Subsurface Soil at Decision Unit 3-1

Site			SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-001-SB107-0204	TF3-001-SB108-0204	TF3-001-SB109-0406
Location ID			TF3-001-SB107	TF3-001-SB108	TF3-001-SB109
Sample Date			11/22/2013	11/22/2013	11/22/2013
Sample Type			N	N	N
Depth Interval			2 - 4 ft	2 - 4 ft	4 - 6 ft
Analytical Parameter	Residential PRG	Industrial PRG			
Semi Volatile Organic Compounds (SVOCs) (mg/kg)					
2-METHYLNAPHTHALENE			< 0.011 UJ	< 0.01 UJ	< 0.011 U
ACENAPHTHENE			< 0.011 U	< 0.01 U	< 0.011 U
ACENAPHTHYLENE			< 0.011 U	< 0.01 U	< 0.011 U
ANTHRACENE			< 0.011 U	< 0.01 U	< 0.011 U
BENZO[A]ANTHRACENE	0.16		< 0.0099 U	< 0.0033 U	< 0.011 U
BENZO[A]PYRENE	0.016		0.01 J	< 0.01 UJ	< 0.011 U
BENZO[B]FLUORANTHENE	0.16		0.019 J	0.0055 J	< 0.011 U
BENZO[G,H,I]PERYLENE			< 0.011 UJ	< 0.01 UJ	< 0.011 U
BENZO[K]FLUORANTHENE			0.0057 J	< 0.01 U	< 0.011 UJ
CHRYSENE			0.011 J	< 0.01 U	0.0029 J
DIBENZ[A,H]ANTHRACENE	0.016		< 0.011 U	< 0.01 U	< 0.011 U
FLUORANTHENE			0.014 J	0.0051 J	0.0029 J
FLUORENE			< 0.011 U	< 0.01 U	< 0.011 U
INDENO[1,2,3-CD]PYRENE	0.16		0.0092 J	0.0026 J	< 0.011 U
NAPHTHALENE	0.8		< 0.011 U	< 0.01 U	< 0.011 U
PHENANTHRENE			0.0057 J	0.0029 J	< 0.011 U
PYRENE			0.013 J	< 0.01 U	0.0031 J
TOTAL PAHs			0.0876	0.0161	0.0089
Petroleum Hydrocarbons (mg/kg)					
Extractable TPH C8-C44			110	71	44
TPH-GASOLINE RANGE C6-C12			< 2.5 U	< 2.4 U	< 2.1 U
Volatile Organic Compounds (mg/kg)					
1,2,4-TRIMETHYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
1,2-DIBROMOETHANE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
1,3,5-TRIMETHYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
2-BUTANONE			0.0098 J	0.012 J	< 0.012 U
2-HEXANONE			< 0.011 UJ	< 0.018 UJ	< 0.012 U
4-ISOPROPYLTOLUENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
4-METHYL-2-PENTANONE			< 0.011 UJ	< 0.018 UJ	< 0.012 U
ACETONE			< 0.14 TB	< 0.25 TB	< 0.043 TB
BENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
BROMOFORM			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
BROMOMETHANE			< 0.0044 UJ	< 0.007 UJ	< 0.005 UJ
CARBON DISULFIDE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
CYCLOHEXANE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
ETHYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
ISOPROPYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
M- AND P-XYLENE			< 0.0044 UJ	< 0.007 UJ	< 0.005 U
METHYL ACETATE			0.016 J	0.021 J	< 0.003 U
METHYL CYCLOHEXANE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
METHYL TERT-BUTYL ETHER			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
NAPHTHALENE	0.8		< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
N-BUTYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
O-XYLENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
PROPYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
SEC-BUTYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
STYRENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
TERT-BUTYLBENZENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
TOLUENE			< 0.0022 UJ	< 0.0035 UJ	< 0.0025 U
XYLENES, TOTAL			< 0.0067 UJ	< 0.01 UJ	< 0.0075 U

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial and Residential PRGs exceeded.

Table 2-4
Analytical Results - Soil at Decision Unit 3-2

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-020-SB102B-0204	TF3-020-SB107-0204	TF3-020-SB107-0204-D	TF3-020-SS101-0001	TF3-020-SB101-0204	TF3-020-SB101-0204-D	TF3-020-SS102A-0001	TF3-020-SS103-0001	TF3-020-SB103-0204
Location ID			TF3-020-SB102B	TF3-020-SB107	TF3-020-SB107	TF3-020-SB101	TF3-020-SB101	TF3-020-SB101	TF3-020-SB102A	TF3-020-SB103	TF3-020-SB103
Sample Date			11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013
Sample Type			N	N	FD	N	N	FD	N	N	N
Depth Interval			2 - 4 ft	2 - 4 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	2 - 4 ft	0 - 1 ft	0 - 1 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG									
PCBs (mg/kg)											
AROCLOR-1016			< 0.0092 U	< 0.0096 U	< 0.0093 U	< 0.01 U	< 0.0088 U	< 0.0092 U	< 0.0096 U	< 0.0082 U	< 0.0092 U
AROCLOR-1221			< 0.0092 U	< 0.0096 U	< 0.0093 U	< 0.01 U	< 0.0088 U	< 0.0092 U	< 0.0096 U	< 0.0082 U	< 0.0092 U
AROCLOR-1232			< 0.011 U	< 0.011 U	< 0.011 U	< 0.012 U	< 0.01 U	< 0.011 U	< 0.011 U	< 0.0097 U	< 0.011 U
AROCLOR-1242			< 0.0092 U	< 0.0096 U	< 0.0093 U	< 0.01 U	< 0.0088 U	< 0.0092 U	< 0.0096 U	< 0.0082 U	< 0.0092 U
AROCLOR-1248			< 0.0092 U	< 0.0096 U	< 0.0093 U	< 0.01 U	< 0.0088 U	< 0.0092 U	< 0.0096 U	< 0.0082 U	< 0.0092 U
AROCLOR-1254			< 0.0092 U	0.15 J	< 0.0093 UJ	0.45	< 0.0088 U	< 0.0092 U	0.14	< 0.0082 U	< 0.0092 U
AROCLOR-1260	1		< 0.0092 U	0.11 J	0.052 J	0.078 J	0.031	< 0.0092 UJ	0.21 J	< 0.0082 U	< 0.0092 U
AROCLOR-1262			< 0.0092 U	< 0.0096 U	< 0.0093 U	< 0.01 U	< 0.0088 U	< 0.0092 U	< 0.0096 U	< 0.0082 U	< 0.0092 U
AROCLOR-1268			< 0.0092 U	< 0.0096 U	< 0.0093 U	< 0.01 U	< 0.0088 U	< 0.0092 U	< 0.0096 U	< 0.0082 U	< 0.0092 U
POLYCHLORINATED BIPHENYLS (PCBS)	1		< 18 U	0.26	0.052	0.528	0.031	< 18 U	0.35	< 16 U	< 18 U
Dioxin/Furans (ng/kg)											
HEXACHLORODIBENZO-P-DIOXIN											
Miscellaneous Parameters (%)											
TOTAL SOLIDS			92	88	88	84	91	92	86	87	92

Table 2-4
Analytical Results - Soil at Decision Unit 3-2

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-020-SB102B-0204	TF3-020-SB107-0204	TF3-020-SB107-0204-D	TF3-020-SS101-0001	TF3-020-SB101-0204	TF3-020-SB101-0204-D	TF3-020-SS102A-0001	TF3-020-SS103-0001	TF3-020-SB103-0204
Location ID			TF3-020-SB102B	TF3-020-SB107	TF3-020-SB107	TF3-020-SB101	TF3-020-SB101	TF3-020-SB101	TF3-020-SB102A	TF3-020-SB103	TF3-020-SB103
Sample Date			11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013
Sample Type			N	N	FD	N	N	FD	N	N	N
Depth Interval			2 - 4 ft	2 - 4 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	2 - 4 ft	0 - 1 ft	0 - 1 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG									
Semi Volatile Organic Compounds (SVOCs) (mg/kg)											
2-METHYLNAPHTHALENE			< 0.01 U	2.2 J	1.4 J						
ACENAPHTHENE			< 0.01 U	4.2 J	2.1 J						
ACENAPHTHYLENE			< 0.01 U	0.15 J	0.097 J						
ANTHRACENE			0.0028 J	4	4.1						
BENZO[A]ANTHRACENE	0.16		0.014 J	2.3	3.1						
BENZO[A]PYRENE	0.016	0.8	0.011 J	0.8 J	1.2 J						
BENZO[B]FLUORANTHENE	0.16		0.031	1.8	2.6						
BENZO[G,H,I]PERYLENE			0.0047 J	0.17 J	0.27 J						
BENZO[K]FLUORANTHENE			0.0089 J	0.7 J	0.98						
CHRYSENE	0.4		0.02 J	2.2	3.4						
DIBENZ[A,H]ANTHRACENE	0.016		0.0094 J	0.51 J	0.37 J						
FLUORANTHENE			0.037	6.2	6.3						
FLUORENE			< 0.01 U	3.8 J	2.2 J						
INDENO[1,2,3-CD]PYRENE	0.16		0.015 J	0.73 J	0.96						
NAPHTHALENE	0.8	0.8	< 0.01 U	8.7	8.8						
PHENANTHRENE			0.0081 J	12	8.6						
PYRENE			0.032	5.5	5.8						
TOTAL PAHs			0.1939	55.96	52.277						
Volatile Organic Compounds (mg/kg)											
1,2,4-TRIMETHYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
1,2-DIBROMOETHANE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
1,3,5-TRIMETHYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
2-BUTANONE			0.0072 J	0.0086 J	0.0087 J						
2-HEXANONE			< 0.012 UJ	< 0.011 UJ	< 0.012 UJ						
4-ISOPROPYLTOLUENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
4-METHYL-2-PENTANONE			< 0.012 UJ	< 0.011 UJ	< 0.012 UJ						
ACETONE			< 0.14 TB	< 0.15 TB	< 0.15 TB						
BENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
BROMOFORM			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
BROMOMETHANE			< 0.005 UJ	< 0.0046 UJ	< 0.005 UJ						
CARBON DISULFIDE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
CYCLOHEXANE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
ETHYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
ISOPROPYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
M- AND P-XYLENE			< 0.005 UJ	< 0.0046 UJ	< 0.005 UJ						
METHYL ACETATE			< 0.003 UJ	< 0.0027 UJ	< 0.003 UJ						
METHYL CYCLOHEXANE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
METHYL TERT-BUTYL ETHER			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
NAPHTHALENE	0.8	0.8	< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
N-BUTYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
O-XYLENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
PROPYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
SEC-BUTYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
STYRENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
TERT-BUTYLBENZENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
TOLUENE			< 0.0025 UJ	< 0.0023 UJ	< 0.0025 UJ						
XYLENES, TOTAL			< 0.0075 UJ	< 0.0068 UJ	< 0.0074 UJ						

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial and Residential PRGs exceeded.

Table 2-4
Analytical Results - Soil at Decision Unit 3-2

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-020-SS104-0001	TF3-020-SB104-0204	TF3-020-SS105-0001	TF3-020-SB105-0204	TF3-020-SS106-0001	TF3-020-SB106-0204	TF3-020-SS107-0001	TF3-020-SS108-0001	TF3-020-SB108-0204
Location ID			TF3-020-SB104	TF3-020-SB104	TF3-020-SB105	TF3-020-SB105	TF3-020-SB106	TF3-020-SB106	TF3-020-SB107	TF3-020-SB108	TF3-020-SB108
Sample Date			11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013
Sample Type			N	N	N	N	N	N	N	N	N
Depth Interval			0 - 1 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	0 - 1 ft	0 - 1 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG									
PCBs (mg/kg)											
AROCLOR-1016			< 0.0093 U	< 0.0089 U	< 0.009 U	< 0.0091 U	< 0.0089 U	< 0.0086 U	< 0.009 U	< 0.0091 U	< 0.0087 U
AROCLOR-1221			< 0.0093 U	< 0.0089 U	< 0.009 U	< 0.0091 U	< 0.0089 U	< 0.0086 U	< 0.009 U	< 0.0091 U	< 0.0087 U
AROCLOR-1232			< 0.011 U	< 0.01 U	< 0.01 U	< 0.011 U	< 0.01 U	< 0.01 U	< 0.011 U	< 0.011 U	< 0.01 U
AROCLOR-1242			< 0.0093 U	< 0.0089 U	< 0.009 U	< 0.0091 U	< 0.0089 U	< 0.0086 U	< 0.009 U	< 0.0091 U	< 0.0087 U
AROCLOR-1248			< 0.0093 U	< 0.0089 U	< 0.009 U	< 0.0091 U	< 0.0089 U	< 0.0086 U	< 0.009 U	< 0.0091 U	< 0.0087 U
AROCLOR-1254			0.026	< 0.0089 U	0.11	< 0.0091 U	< 0.0089 U	< 0.0086 U	0.14	< 0.0091 U	< 0.0087 U
AROCLOR-1260	1		0.089	< 0.0089 UJ	0.1	< 0.0091 U	2.1	0.11	0.18	0.085	< 0.0087 U
AROCLOR-1262			< 0.0093 U	< 0.0089 U	< 0.009 U	< 0.0091 U	< 0.0089 U	< 0.0086 U	< 0.009 U	< 0.0091 U	< 0.0087 U
AROCLOR-1268			< 0.0093 U	< 0.0089 U	< 0.009 U	< 0.0091 U	< 0.0089 U	< 0.0086 U	< 0.009 U	< 0.0091 U	< 0.0087 U
POLYCHLORINATED BIPHENYLS (PCBS)	1		0.115	< 18 U	0.21	< 18 U	2.1	0.11	0.32	0.085	< 17 U
Dioxin/Furans (ng/kg)											
HEXACHLORODIBENZO-P-DIOXIN											
Miscellaneous Parameters (%)											
TOTAL SOLIDS			90	92	88	93	87	93	89	88	92

Table 2-4
Analytical Results - Soil at Decision Unit 3-2

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-020-SS104-0001	TF3-020-SB104-0204	TF3-020-SS105-0001	TF3-020-SB105-0204	TF3-020-SS106-0001	TF3-020-SB106-0204	TF3-020-SS107-0001	TF3-020-SS108-0001	TF3-020-SB108-0204
Location ID			TF3-020-SB104	TF3-020-SB104	TF3-020-SB105	TF3-020-SB105	TF3-020-SB106	TF3-020-SB106	TF3-020-SB107	TF3-020-SB108	TF3-020-SB108
Sample Date			11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013	11/18/2013
Sample Type			N	N	N	N	N	N	N	N	N
Depth Interval			0 - 1 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	0 - 1 ft	0 - 1 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG									
Semi Volatile Organic Compounds (SVOCs) (mg/kg)											
2-METHYLNAPHTHALENE											
ACENAPHTHENE											
ACENAPHTHYLENE											
ANTHRACENE											
BENZO[A]ANTHRACENE	0.16										
BENZO[A]PYRENE	0.016	0.8									
BENZO[B]FLUORANTHENE	0.16										
BENZO[G,H,I]PERYLENE											
BENZO[K]FLUORANTHENE											
CHRYSENE	0.4										
DIBENZ[A,H]ANTHRACENE	0.016										
FLUORANTHENE											
FLUORENE											
INDENO[1,2,3-CD]PYRENE	0.16										
NAPHTHALENE	0.8	0.8									
PHENANTHRENE											
PYRENE											
TOTAL PAHs											
Volatile Organic Compounds (mg/kg)											
1,2,4-TRIMETHYLBENZENE											
1,2-DIBROMOETHANE											
1,3,5-TRIMETHYLBENZENE											
2-BUTANONE											
2-HEXANONE											
4-ISOPROPYLTOLUENE											
4-METHYL-2-PENTANONE											
ACETONE											
BENZENE											
BROMOFORM											
BROMOMETHANE											
CARBON DISULFIDE											
CYCLOHEXANE											
ETHYLBENZENE											
ISOPROPYLBENZENE											
M- AND P-XYLENE											
METHYL ACETATE											
METHYL CYCLOHEXANE											
METHYL TERT-BUTYL ETHER											
NAPHTHALENE	0.8	0.8									
N-BUTYLBENZENE											
O-XYLENE											
PROPYLBENZENE											
SEC-BUTYLBENZENE											
STYRENE											
TERT-BUTYLBENZENE											
TOLUENE											
XYLENES, TOTAL											

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial and Residential PRGs exceeded.

Table 2-4
Analytical Results - Soil at Decision Unit 3-2

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-020-SS109-0001	TF3-020-SB109-0204	TF3-020-SS110-0001	TF3-020-SB110-0204	TF3-TF1-A	TF3-TF1-B	TF3-TF1-C	TF3-TF1-D	TF3-TF2-A	TF3-TF2-B	TF3-TF2-C	TF3-TF2-D
Location ID			TF3-020-SB109	TF3-020-SB109	TF3-020-SB110	TF3-020-SB110	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004
Sample Date			11/18/2013	11/18/2013	11/18/2013	11/18/2013	TF3-TF1-A	TF3-TF1-B	TF3-TF1-C	TF3-TF1-D	TF3-TF2-A	TF3-TF2-B	TF3-TF2-C	TF3-TF2-D
Sample Type			N	N	N	N	N	N	N	N	N	N	N	N
Depth Interval			0 - 1 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 ft
Analytical Parameter	Residential PRG	Industrial PRG												
PCBs (mg/kg)														
AROCLOR-1016			< 0.0092 U	< 0.0082 U	< 0.0089 U	< 0.0084 U								
AROCLOR-1221			< 0.0092 U	< 0.0082 U	< 0.0089 U	< 0.0084 U								
AROCLOR-1232			< 0.011 U	< 0.0097 U	< 0.01 U	< 0.0099 U								
AROCLOR-1242			< 0.0092 U	< 0.0082 U	< 0.0089 U	< 0.0084 U	0.11 U	0.12 U	0.11 U	0.28	0.25	0.11 U	1.1 U	0.11 U
AROCLOR-1248			< 0.0092 U	< 0.0082 U	< 0.0089 U	< 0.0084 U								
AROCLOR-1254			0.33	< 0.0082 U	0.14	< 0.0084 U	0.11 U	0.12 U	0.11 U	0.93	1.2	0.11 U	1.1 U	0.11 U
AROCLOR-1260	1		0.22	0.0068 J	0.18 J	0.088 J	0.11 U	0.12 U	0.11 U	0.12 U	0.11 U	0.11 U	8.2	0.11 U
AROCLOR-1262			< 0.0092 U	< 0.0082 U	< 0.0089 U	< 0.0084 U								
AROCLOR-1268			< 0.0092 U	< 0.0082 U	< 0.0089 U	< 0.0084 U								
POLYCHLORINATED BIPHENYLS (PCBS)	1		0.55	0.0068	0.32	0.088	0 U	0 U	0 U	1.21	1.45	0	8.2	0 U
Dioxin/Furans (ng/kg)														
HEXACHLORODIBENZO-P-DIOXIN							85.1	81.3	85.4	83.3	84.9	89.2	91.6	85.8
Miscellaneous Parameters (%)														
TOTAL SOLIDS			88	90	90	90								

Table 2-4
Analytical Results - Soil at Decision Unit 3-2

Site			SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID			TF3-020-SS109-0001	TF3-020-SB109-0204	TF3-020-SS110-0001	TF3-020-SB110-0204	TF3-TF1-A	TF3-TF1-B	TF3-TF1-C	TF3-TF1-D	TF3-TF2-A	TF3-TF2-B	TF3-TF2-C	TF3-TF2-D
Location ID			TF3-020-SB109	TF3-020-SB109	TF3-020-SB110	TF3-020-SB110	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004	10/8/2004
Sample Date			11/18/2013	11/18/2013	11/18/2013	11/18/2013	TF3-TF1-A	TF3-TF1-B	TF3-TF1-C	TF3-TF1-D	TF3-TF2-A	TF3-TF2-B	TF3-TF2-C	TF3-TF2-D
Sample Type			N	N	N	N	N	N	N	N	N	N	N	N
Depth Interval			0 - 1 ft	2 - 4 ft	0 - 1 ft	2 - 4 ft	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 FT	0 - 1 ft
Analytical Parameter	Residential PRG	Industrial PRG												
Semi Volatile Organic Compounds (SVOCs) (mg/kg)														
2-METHYLNAPHTHALENE														
ACENAPHTHENE														
ACENAPHTHYLENE														
ANTHRACENE														
BENZO[A]ANTHRACENE	0.16													
BENZO[A]PYRENE	0.016	0.8												
BENZO[B]FLUORANTHENE	0.16													
BENZO[G,H,I]PERYLENE														
BENZO[K]FLUORANTHENE														
CHRYSENE	0.4													
DIBENZ[A,H]ANTHRACENE	0.016													
FLUORANTHENE														
FLUORENE														
INDENO[1,2,3-CD]PYRENE	0.16													
NAPHTHALENE	0.8	0.8												
PHENANTHRENE														
PYRENE														
TOTAL PAHs														
Volatile Organic Compounds (mg/kg)														
1,2,4-TRIMETHYLBENZENE														
1,2-DIBROMOETHANE														
1,3,5-TRIMETHYLBENZENE														
2-BUTANONE														
2-HEXANONE														
4-ISOPROPYLTOLUENE														
4-METHYL-2-PENTANONE														
ACETONE														
BENZENE														
BROMOFORM														
BROMOMETHANE														
CARBON DISULFIDE														
CYCLOHEXANE														
ETHYLBENZENE														
ISOPROPYLBENZENE														
M- AND P-XYLENE														
METHYL ACETATE														
METHYL CYCLOHEXANE														
METHYL TERT-BUTYL ETHER														
NAPHTHALENE	0.8	0.8												
N-BUTYLBENZENE														
O-XYLENE														
PROPYLBENZENE														
SEC-BUTYLBENZENE														
STYRENE														
TERT-BUTYLBENZENE														
TOLUENE														
XYLENES, TOTAL														

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial and Residential PRGs exceeded.

Table 2-5a

Analytical Results - Surface Soil at Decision Unit 3-3

Site				SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID				TF3-ECH-SS101-0001	TF3-ECH-SS102-0001	TF3-ECH-SS103-0001	TF3-ECH-SS104-0001	TF3-ECH-SS105-0001	TF3-ECH-SS106-0001	TF3-ECH-SS107-0001	TF3-ECH-SS108-0001-D	TF3-ECH-SS108-0001
Location ID				TF3-ECH-SB101	TF3-ECH-SB102	TF3-ECH-SB103	TF3-ECH-SB104	TF3-ECH-SB105	TF3-ECH-SB106	TF3-ECH-SB107	TF3-ECH-SB108	TF3-ECH-SB108
Sample Date				11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013
Sample Type				N	N	N	N	N	N	N	FD	N
Depth Interval				0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft
Analytical Parameter	Residential PRG	Industrial PRG	Ecological PRG									
Metals (mg/kg)												
ALUMINUM				10900	9970	8830	7660	10800	9960	11500	11500	11500
ANTIMONY				0.08 J	0.06 J	0.2 J	0.11 J	0.08 J	0.12 J	0.1 J	0.35 J	0.3 J
ARSENIC	17			3.9	4.3	3.4	6.3	4.1	3.8	3.2	3.8	3.7
BARIUM				25.2	20.1	23.4	19.7	24.2	21.8	21.1	30.1	27.9
BERYLLIUM				0.44	0.52	0.37	0.31	0.38	0.4	0.36	0.41	0.43
CADMIUM				0.09 J	0.06 J	0.29	0.11	0.08	0.08	0.1	0.43	0.24
CALCIUM				1420 J	470 J	2890 J	2590 J	619 J	879 J	1580 J	3400 J	3990 J
CHROMIUM, TOTAL	0.31			12.6	12.5	11.2	11.6	12.8	12.2	13.2	19.8	13.2
COBALT				7.1	9.2	5.8	8.5	7.3	10.5	7.4	7.3	6.6
COPPER				13.8	13.6	58.2	18.3	12.8	16	12.7	63.8 J	25.3 J
IRON				16400	18600	13900	17800	17700	17600	18700	17000	16600
LEAD	150			17.4	10.1	299	23.3	21.2	24.9	13.3	72.2 J	32.9 J
MAGNESIUM				2450	2960	2310	3110	2600	2550	3240	3030	2980
MANGANESE	390			240	269	211	317	257	303	317	240	252
MERCURY				0.1	< 0.015 U	0.04	< 0.02 U	0.03 J	0.03 J	0.03 J	< 0.02 U	0.03
NICKEL				12.1	13.2	10.5	14.1	12.7	12.9	14.3	11.8	11.2
POTASSIUM				560	540	450	460	477	524	642	671	683
SELENIUM				0.38 J	0.27 J	0.26 J	0.22 J	0.27 J	0.28 J	0.4	0.35	0.44
SILVER				0.05 J	0.03 J	0.07	0.05 J	0.06 J	0.03 J	0.04 J	0.07	0.05 J
SODIUM				47.7 J	< 28.1 U	< 32.7 U	< 66.7 U	< 36.1 U	< 39.8 U	43.5 J	47.5 J	63.4 J
THALLIUM				0.09 J	0.07	0.06	0.05 J	0.08	0.08	0.07	0.08	0.09
VANADIUM				19.2	15.4	14.4	26.5	17.4	16.3	18.5	19.6	18.8
ZINC				46.9	32.7	48.1	40.7	35.4	34.5	52	53.8	43.4
PCBs (mg/kg)												
AROCLOR-1016				< 0.0092 U	< 0.0091 U	< 0.0083 U	< 0.047 U	< 0.009 U	< 0.0089 U	< 0.0093 U	< 0.83 U	< 0.36 U
AROCLOR-1221				< 0.0092 U	< 0.0091 U	< 0.0083 U	< 0.047 U	< 0.009 U	< 0.0089 U	< 0.0093 U	< 0.83 U	< 0.36 U
AROCLOR-1232				< 0.011 U	< 0.011 U	< 0.0098 U	< 0.056 U	< 0.011 U	< 0.01 U	< 0.011 U	< 0.98 U	< 0.42 U
AROCLOR-1242				< 0.0092 U	< 0.0091 U	< 0.0083 U	< 0.047 U	< 0.009 U	< 0.0089 U	< 0.0093 U	< 0.83 U	< 0.36 U
AROCLOR-1248				< 0.0092 U	< 0.0091 U	< 0.0083 U	< 0.047 U	< 0.009 U	< 0.0089 U	< 0.0093 U	< 0.83 U	< 0.36 U
AROCLOR-1254				< 0.0092 U	< 0.0091 U	< 0.0083 U	< 0.047 U	< 0.009 U	< 0.0089 U	< 0.0093 U	< 0.83 U	< 0.36 U
AROCLOR-1260	1	10	3.6	0.12	0.065 J	2.8 J	< 0.047 UJ	0.064 J	0.14 J	0.22	77 J	140 J
AROCLOR-1262				< 0.0092 U	< 0.0091 U	< 0.0083 U	< 0.047 U	< 0.009 U	< 0.0089 U	< 0.0093 U	< 0.83 U	< 0.36 U
AROCLOR-1268				< 0.0092 U	< 0.0091 U	< 0.0083 U	< 0.047 U	< 0.009 U	< 0.0089 U	< 0.0093 U	< 0.83 U	< 0.36 U
POLYCHLORINATED BIPHENYLS (PCBS)				0.12	0.065	2.8	< 95 U	0.064	0.14	0.22	77	140
Miscellaneous Parameters (%)												
TOTAL SOLIDS				86	88	91	90	88	89	89	90	90
Petroleum Hydrocarbons (mg/kg)												
Extractable TPH C8-C44				120	18 J	120	430 J	63	71	110	460	550
TPH-GASOLINE RANGE C6-C12				< 2.7 U	< 2.7 U	< 2.7 U	< 2.2 U	< 2.3 U	< 2.6 U	< 2.6 U	< 2.3 U	< 2.3 U

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial, Residential, and Ecological (if applicable) PRGs exceeded.
3. Purple shading indicates Residential and Ecological PRGs exceeded.

Table 2-5a

Analytical Results - Surface Soil at Decision Unit 3-3

Site				SITE 00011	SITE 00011
Sample ID				TF3-ECH-SS109-0001	TF3-ECH-SS110-0001
Location ID				TF3-ECH-SB109	TF3-ECH-SB110
Sample Date				11/19/2013	11/19/2013
Sample Type				N	N
Depth Interval				0 - 1 ft	0 - 1 ft
Analytical Parameter	Residential PRG	Industrial PRG	Ecological PRG		
Metals (mg/kg)					
ALUMINUM				12400	13900
ANTIMONY				0.08 J	0.05 J
ARSENIC	17			3.9	3.6
BARIUM				24.3	23.5
BERYLLIUM				0.47	0.46
CADMIUM				0.09	0.04 J
CALCIUM				925 J	914 J
CHROMIUM, TOTAL	0.31			14.2	13.7
COBALT				8.9	5.3
COPPER				13.3	5.6
IRON				23200	15000
LEAD	150			11	7.6
MAGNESIUM				3150	1990
MANGANESE	390			314	165
MERCURY				< 0.02 U	< 0.02 U
NICKEL				14.3	9.4
POTASSIUM				609	475
SELENIUM				0.36 J	0.53
SILVER				0.04 J	0.07 J
SODIUM				41 J	50 J
THALLIUM				0.09	0.1
VANADIUM				22	22
ZINC				39.4	26.9
PCBs (mg/kg)					
AROCLOR-1016				< 0.0094 U	< 0.0098 U
AROCLOR-1221				< 0.0094 U	< 0.0098 U
AROCLOR-1232				< 0.011 U	< 0.012 U
AROCLOR-1242				< 0.0094 U	< 0.0098 U
AROCLOR-1248				< 0.0094 U	< 0.0098 U
AROCLOR-1254				< 0.0094 U	< 0.0098 U
AROCLOR-1260	1	10	3.6	1.8	0.15 J
AROCLOR-1262				< 0.0094 U	< 0.0098 U
AROCLOR-1268				< 0.0094 U	< 0.0098 U
POLYCHLORINATED BIPHENYLS (PCBS)				1.8	0.15
Miscellaneous Parameters (%)					
TOTAL SOLIDS				88	86
Petroleum Hydrocarbons (mg/kg)					
Extractable TPH C8-C44				42 J	12 J
TPH-GASOLINE RANGE C6-C12				< 2.4 U	< 2.6 U

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial, Residential, and Ecological (if applicable) PF
3. Purple shading indicates Residential and Ecological PRGs exceeded.

Table 2-5b

Analytical Results - Subsurface Soil at Decision Unit 3-3

Site					SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID					TF3-ECH-SB101-0204	TF3-ECH-SB102-0204	TF3-ECH-SB103-0204	TF3-ECH-SB104-0204	TF3-ECH-SB105-0204	TF3-ECH-SB106-0204-D	TF3-ECH-SB106-0204
Location ID					TF3-ECH-SB101	TF3-ECH-SB102	TF3-ECH-SB103	TF3-ECH-SB104	TF3-ECH-SB105	TF3-ECH-SB106	TF3-ECH-SB106
Sample Date					11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013	11/19/2013
Sample Type					N	N	N	N	N	FD	N
Depth Interval					2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG	Ecological PRG	report_result_unit							
Metals (mg/kg)											
ALUMINUM				MG_KG	10700	9300	10100	14100	10000	9880	10100
ANTIMONY				MG_KG	0.06 J	0.08 J	0.05 J	< 0.038 U	0.05 J	0.07 J	0.05 J
ARSENIC	7			MG_KG	3.8	4.1	3.8	3.6	5.1	3.7	3.7
BARIUM				MG_KG	23.6	18.9	21.8	28.8	24.1	19.8	22.1
BERYLLIUM				MG_KG	0.44	0.38	0.41	0.34	0.41	0.39	0.36
CADMIUM				MG_KG	0.06 J	0.05 J	0.05 J	0.04 J	0.05 J	0.09	0.06 J
CALCIUM				MG_KG	789 J	541 J	710 J	631 J	421 J	860 J	1440 J
CHROMIUM, TOTAL	0.31			MG_KG	12.7	11.1	12.4	14.7	12.4	12.7	12.6
COBALT				MG_KG	6.8	6.4	7.3	6.8	7.1	7.8	8.6
COPPER				MG_KG	11.4	11.1	12.9	6.8	9.3	13.4	13.9
IRON				MG_KG	16300	17500	17600	15200	14000	19500	19000
LEAD	150			MG_KG	8.2	7.8	8.1	7.2	6.5	11.9	13.1
MAGNESIUM				MG_KG	2430	2380	2790	2330	2170	2900	3140
MANGANESE	460			MG_KG	205	178	213	211	235	288	316
MERCURY				MG_KG	< 0.02 U	< 0.015 U	< 0.02 U	0.04	< 0.02 U	0.04	< 0.02 U
NICKEL				MG_KG	10.6	10.8	12.6	9.6	9.1	15.1	14.4
POTASSIUM				MG_KG	615	553	637	765	484	573	725
SELENIUM				MG_KG	0.29 J	0.39	0.24 J	0.48	0.23 J	0.27 J	0.22 J
SILVER				MG_KG	0.03 J	0.02 J	0.02 J	0.09	0.04 J	0.03 J	0.04 J
SODIUM				MG_KG	46.6 J	33.3 J	< 35.7 U	< 50.9 U	< 33.6 U	< 30 U	< 35.9 U
THALLIUM				MG_KG	0.09	0.08	0.08 J	0.13	0.09	0.07 J	0.08
VANADIUM				MG_KG	17.8	16.7	15.7	21.6	18.1	15.2	16.5
ZINC				MG_KG	28	27.5	30.4	24.7	21.2	46.4	42.9
PCBs (mg/kg)											
AROCLOR-1016				MG_KG	< 0.0094 U	< 0.0093 U	< 0.0087 U	< 0.01 U	< 0.0086 U	< 0.0092 U	< 0.042 U
AROCLOR-1221				MG_KG	< 0.0094 U	< 0.0093 U	< 0.0087 U	< 0.01 U	< 0.0086 U	< 0.0092 U	< 0.042 U
AROCLOR-1232				MG_KG	< 0.011 U	< 0.011 U	< 0.01 U	< 0.012 U	< 0.01 U	< 0.011 U	< 0.05 U
AROCLOR-1242				MG_KG	< 0.0094 U	< 0.0093 U	< 0.0087 U	< 0.01 U	< 0.0086 U	< 0.0092 U	< 0.042 U
AROCLOR-1248				MG_KG	< 0.0094 U	< 0.0093 U	< 0.0087 U	< 0.01 U	< 0.0086 U	< 0.0092 U	< 0.042 U
AROCLOR-1254				MG_KG	< 0.0094 U	< 0.0093 U	< 0.0087 U	< 0.01 U	< 0.0086 U	< 0.0092 U	< 0.042 U
AROCLOR-1260	1	10	3.6	MG_KG	< 0.0094 U	< 0.0093 U	0.022 J	< 0.01 UJ	< 0.0086 UJ	0.21 J	0.2 J
AROCLOR-1262				MG_KG	< 0.0094 U	< 0.0093 U	< 0.0087 U	< 0.01 U	< 0.0086 U	< 0.0092 U	< 0.042 U
AROCLOR-1268				MG_KG	< 0.0094 U	< 0.0093 U	< 0.0087 U	< 0.01 U	< 0.0086 U	< 0.0092 U	< 0.042 U
POLYCHLORINATED BIPHENYLS (PCBS)				MG_KG	< 19 U	< 19 U	0.022	< 20 U	< 17 U	0.21	0.2
Miscellaneous Parameters (%)											
TOTAL SOLIDS				PCT	89	88	93	82	88	91	90
Petroleum Hydrocarbons (mg/kg)											
Extractable TPH C8-C44				MG_KG	8.9 J	9.1 J	6.6 J	13 J	8.4 J	170 J	210 J
TPH-GASOLINE RANGE C6-C12				MG_KG	< 2.4 U	< 2.5 U	< 2.1 U	< 2.4 U	< 2.4 U	< 1.4 U	< 2 U

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial, Residential, and Ecological (if applicable) PRGs exceeded.
3. Purple shading indicates Residential and Ecological PRGs exceeded.

Table 2-5b

Analytical Results - Subsurface Soil at Decision Unit 3-3

Site				SITE 00011	SITE 00011	SITE 00011	SITE 00011
Sample ID				TF3-ECH-SB107-0204	TF3-ECH-SB108-0204	TF3-ECH-SB109-0204	TF3-ECH-SB110-0204
Location ID				TF3-ECH-SB107	TF3-ECH-SB108	TF3-ECH-SB109	TF3-ECH-SB110
Sample Date				11/19/2013	11/19/2013	11/19/2013	11/19/2013
Sample Type				N	N	N	N
Depth Interval				2 - 4 ft	2 - 4 ft	2 - 4 ft	2 - 4 ft
Analytical Parameter	Residential PRG	Industrial PRG	Ecological PRG				
Metals (mg/kg)							
ALUMINUM				10900	10300	11200	9260
ANTIMONY				0.07 J	0.12 J	0.06 J	0.06 J
ARSENIC	7			3.6	3.5	3.4	4.1
BARIUM				22.2	22.1	24.9	19.2
BERYLLIUM				0.39	0.4	0.47	0.44
CADMIUM				0.05 J	0.13	0.11	0.07 J
CALCIUM				1200 J	856 J	1200 J	838 J
CHROMIUM, TOTAL	0.31			11.5	13.4	14.3	10.9
COBALT				6.3	7.2	9.5	7.6
COPPER				10.6	11.5	17.8	10.9
IRON				16200	17700	21900	16000
LEAD	150			8.9	21.5	20.1	6.7
MAGNESIUM				2510	2660	3540	2330
MANGANESE	460			235	231	336	273
MERCURY				< 0.014 U	< 0.013 U	< 0.01 U	< 0.016 U
NICKEL				10.5	11.3	15.4	11.3
POTASSIUM				574	768	875	661
SELENIUM				0.26 J	0.23 J	0.25 J	0.25 J
SILVER				0.04 J	0.03 J	0.03 J	0.03 J
SODIUM				42 J	46.6 J	41 J	53.8 J
THALLIUM				0.07 J	0.09	0.1	0.09
VANADIUM				15.8	17.1	25.4	17.3
ZINC				28.3	32	68.8	27.2
PCBs (mg/kg)							
AROCLOR-1016				< 0.0089 U	< 0.18 U	< 0.01 U	< 0.0091 U
AROCLOR-1221				< 0.0089 U	< 0.18 U	< 0.01 U	< 0.0091 U
AROCLOR-1232				< 0.01 U	< 0.21 U	< 0.012 U	< 0.011 U
AROCLOR-1242				< 0.0089 U	< 0.18 U	< 0.01 U	< 0.0091 U
AROCLOR-1248				< 0.0089 U	< 0.18 U	< 0.01 U	< 0.0091 U
AROCLOR-1254				< 0.0089 U	< 0.18 U	< 0.01 U	< 0.0091 U
AROCLOR-1260	1	10	3.6	0.062	7.6	0.69	0.21
AROCLOR-1262				< 0.0089 U	< 0.18 U	< 0.01 U	< 0.0091 U
AROCLOR-1268				< 0.0089 U	< 0.18 U	< 0.01 U	< 0.0091 U
POLYCHLORINATED BIPHENYLS (PCBS)				0.062	7.6	0.69	0.21
Miscellaneous Parameters (%)							
TOTAL SOLIDS				91	93	77	91
Petroleum Hydrocarbons (mg/kg)							
Extractable TPH C8-C44				16 J	46 J	13 J	12 J
TPH-GASOLINE RANGE C6-C12				< 2.2 U	< 2 U	< 2.8 U	< 1.9 U

Notes:

1. Red shading indicates Residential PRG exceeded.
2. Blue shading indicates Industrial, Residential, and Ecological (if applicable) PRGs exceeded.
3. Purple shading indicates Residential and Ecological PRGs exceeded.

Table 2-6
Technology & Process Option Screening for Soil

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING
NO ACTION	**NONE**	**NONE**	No remedial or response action taken within the Site.	POTENTIALLY APPLICABLE: Required as a baseline evaluation by the NCP.
LIMITED ACTION	**ACCESS RESTRICTIONS**	**INSTITUTIONAL CONTROLS**	Administrative action using site use prohibitions to restrict future use, activities, and digging.	POTENTIALLY APPLICABLE: Effective in mitigating site risk by cutting risk pathway to receptors
		FENCING & SECURITY MEASURES	Placement of fencing, security alarms, etc. around the site boundary to limit public exposure to surface soils.	SCREENED OUT A fence currently prevents access to the Site. Not appropriate since RIDEM RDEC and I/C DEC exceedances are present in surface soil and potential receptors include residents and commercial and industrial workers.
	MONITORING	**GROUNDWATER MONITORING**	Analytical testing of site groundwater samples to identify migration of COCs from soil to groundwater so that other actions can be considered.	POTENTIALLY APPLICABLE: Effective in monitoring potential future contaminant migration to groundwater if contaminated soils are left in place.
SOURCE CONTROL	**HORIZONTAL CONTAINMENT**	**NATIVE SOIL OR SINGLE BARRIER CAP**	Cover area of contaminated soils with either common earth and vegetate, low permeability asphalt, soil, or geomembrane.	POTENTIALLY APPLICABLE: Effective in preventing direct contact with contaminated soils and reducing site risks.
		COMPOSITE / DOUBLE BARRIER CAP	Cover area of waste disposal with a low permeability double soil and / or geomembrane cap.	SCREENED OUT: Not as cost effective as other containment options.
	EXCAVATION & ON-SITE DISPOSAL	**NATIVE SOIL SINGLE OR DOUBLE BARRIER CAP**	Excavate hot spots and place under on-site protective soil cover.	POTENTIALLY APPLICABLE: Effective in preventing exposure to contaminated soils. Would allow for UU/UE of excavated area.

Table 2-6
Technology & Process Option Screening for Soil

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING
SOURCE CONTROL	**EXCAVATION & OFF-SITE TREATMENT/DISPOSAL**	**RCRA SUBTITLE D LANDFILL FACILITY**	Excavate hot spots and transport for disposal in RCRA Subtitle D landfill.	POTENTIALLY APPLICABLE: Cost-effective for small volumes of soil.
		RCRA TSD FACILITY	Excavate hot spots and transport to licensed RCRA treatment, storage and disposal (TSD) facility for ultimate disposition of waste materials.	SCREENED OUT: Other disposal options are more cost-effective.
		SOLIDIFICATION/ STABILIZATION FACILITY	Contaminants are physically bound or enclosed within a stabilized mass (solidification, i.e. asphalt batch processing), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	SCREENED OUT: Other disposal options are more cost-effective.
TREATMENT: IN-SITU	**PHYSICAL PROCESSES**	**SOIL VAPOR EXTRACTION**	A vacuum is applied to a network of aboveground piping to encourage volatilization of organics from the excavated media. The process includes a system for handling off-gases.	SCREENED OUT: Not effective in treating COCs (PAHs, PCBs, metals, and dioxins).
		ELECTROKINETIC PROCESSES	Application of a low current to electrodes in the subsurface in order to mobilize contaminants in two ways: (1) in the form of charged species (electrolysis); or (2) by causing an imbalance of charge bonds in clayey material, which results in clay compaction and chemical desorption (electro-osmosis).	SCREENED OUT: Overly complex and not cost effective for treating shallow soils.

Table 2-6
Technology & Process Option Screening for Soil

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING
TREATMENT: IN-SITU (continued)	**BIOLOGICAL PROCESSES**	**MONITORED NATURAL ATTENUATION**	Naturally occurring processes in the environment that reduce the concentration of COCs in soils.	SCREENED OUT: Not effective in reducing concentrations of COCs (PAHs, PCBs, metals, and dioxins).
		ENHANCED BIODEGRADATION	Enhancement of natural microbial breakdown by addition of nutrients, co-substrates and oxygen sources via injection wells.	SCREENED OUT: Not effective in reducing concentrations of some COCs (PCBs, metals, and dioxins).
		BIOVENTING	Oxygen is delivered to contaminated unsaturated soils by forced air movement (either extraction or injection of air) to increase oxygen concentrations and stimulate biodegradation.	SCREENED OUT: Not as cost-effective as other process options for treating shallow soils.
		LAND TREATMENT	Contaminated soil is treated in place by tilling to achieve aeration, and if necessary, by addition of amendments. Periodically tilling, to aerate the waste, enhances the biological activity.	SCREENED OUT: Not effective in removing some of the COCs (PCBs, metals, and dioxins)
		PHYTO-REMEDIATION	Removal of contaminants by plant roots from shallow soil and sediment through the processes of phytoaccu-mulation, phytodegradation and phyto-stabilization.	SCREENED OUT: Limited effectiveness in treating inorganic COCs in soils. Technology best for organics in soils/sediments and inorganics in water.
	CHEMICAL PROCESSES	**SOIL FLUSHING**	Removal of contaminants from the soil by water or other suitable aqueous solutions through an injection or infiltration process.	SCREENED OUT: Not as cost-effective as other process options for treating shallow soils.
		CHEMICAL REDUCTION/ OXIDATION	Reduction/oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	SCREENED OUT: Not as cost-effective as other process options for treating shallow soils.
		SOLIDIFICATION & STABILIZATION	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	SCREENED OUT: Most effective for reducing leaching, which is not the primary concern at this site.

Table 2-6
Technology & Process Option Screening for Soil

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING
TREATMENT: IN-SITU (continued)	**THERMAL PROCESSES**	**THERMALLY ENHANCED SOIL VAPOR EXTRACTION**	Steam/hot air injection or electrical resistance/electromagnetic/fiber optic/radio frequency heating is used to increase the volatilization rate of semi-volatiles and facilitate extraction.	POTENTIALLY APPLICABLE: The most cost-effective in-situ treatment option.
		VITRIFICATION	Heating of soils to a molten state by electordes which dstroy organics and form a glassy matrix as soils cool.	SCREENED OUT: Not as cost-effective as other process options for treating shallow soils.
TREATMENT: ON-SITE	**PHYSICAL PROCESSES**	**ELECTROKINETIC PROCESSES**	Removal of contaminanants through application of low-intensity direct current into the soil to mobilize charged species (ions and water) towards the electrodes.	SCREENED OUT: Effective in removal of inorganic site COCs, but at a much slower rate than other process options.
	CHEMICAL PROCESSES	**CHEMICAL EXTRACTION**	Waste contaminated soil and extractant are mixed in an extractor, dissolving the contaminants. The extracted solution is then placed in a separator, where the contaminants and extractant are separated for further treatment.	SCREENED OUT: Other treatment technologies are more cost effective given there are both organic and inorganic COCs.
		SOLIDIFICATION & STABILIZATION	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	SCREENED OUT: Most effective for reducing leaching, which is not the primary concern at this site.
		CHEMICAL REDUCTION/ OXIDATION	Reduction/oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	SCREENED OUT: Other treatment technologies are more cost-effective with equivalent mitigation of risks for site COCs.
		DEHALOGENATION	Reagents are added to soils contaminated with halogenated organics. The dehalogenation process is achieved by either the replacement of the halogen molecules or the decomposition and partial volatilization of the contaminants.	SCREENED OUT: Not effective in removing the primary site COCs; technology is primarily used for chlorinated compounds.

Table 2-6
Technology & Process Option Screening for Soil

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING
TREATMENT: ON-SITE (continued)	**CHEMICAL PROCESSES (continued)**	**SOIL WASHING**	Contaminants sorbed onto fine soil particles are separated from bulk soil in an aqueous-based system on the basis of particle size. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics and heavy metals.	SCREENED OUT: Other treatment technologies are more cost effective given there are both organic and inorganic COCs.
	BIOLOGICAL PROCESSES	**SLURRY PHASE BIOLOGICAL TREATMENT**	An aqueous slurry is created by combining soil, sediment, or sludge with water and other additives. The slurry is mixed to keep solids suspended and microorganisms in contact with the soil contaminants. Upon completion of the process, the slurry is dewatered and the treated soil is disposed of.	SCREENED OUT: Not effective in removing some of the COCs (PAHs and metals)
		COMPOSTING	Contaminated soil is excavated and mixed with bulking agents and organic amendments such as wood chips, hay, manure, and vegetative (e.g., potato) wastes. Proper amendment selection ensure adequate porosity and provides a balance of carbon and nitrogen to degradation of contaminants to non-toxic products.	SCREENED OUT: Not effective in removing some of the COCs (PCBs, metals, and dioxins).
		BIOPILES	Excavated soils are mixed with soil amendments and placed in aboveground enclosures. It is an aerated static pile composting process in which compost is formed into piles and aerated with blowers or vacuum pumps.	SCREENED OUT: Not effective in removing the primary site COCs s (PCBs, metals, and dioxins).
		LAND TREATMENT	Treatment of contaminants through dynamic interactions of wastes with soil, climate and biological activity. Wastes are tilled periodically to create aeration.	SCREENED OUT: Not effective in removing the primary site COCs (PCBs, metals, and dioxins)

Table 2-6
Technology & Process Option Screening for Soil

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	TECHNOLOGY DESCRIPTION	SCREENING
TREATMENT: ON-SITE (continued)	**THERMAL PROCESSES**	**PYROLYSIS**	Removal of contaminants through induction of chemical decomposition in organic materials by heat in the absence of oxygen.	SCREENED OUT: Other treatment technologies are more cost-effective with equivalent mitigation of risks for site organic COCs.
		INCINERATION	High temperatures are used to combust (in the presence of oxygen) organic constituents in hazardous wastes.	SCREENED OUT: Other treatment technologies are more cost-effective with equivalent mitigation of risks for site organic COCs.
		THERMAL DESORPTION	Wastes are heated to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to the gas treatment system.	SCREENED OUT: Other treatment technologies are more cost-effective with equivalent mitigation of risks for site organic COCs.
		PYRO-METALLURGICAL EXTRACTION	Utilizes elevated temperature extraction and processing for removal of metals from contaminated soils. Soils are treated in a high- temperature furnace to remove volatile metals from the solid phase. Subsequent treatment steps may include metal recovery or immobilization.	SCREENED OUT: Not effective in removing the primary site COCs; technology is primarily used for metals such as Hg.

KEY: [hatched box] Technology / Process Option screened from further evaluation.

Table 3-1
Components of Soil Remedial Alternatives

Alternative	Key Components
S-1: No Action	• No remedial action • For comparison only
S-2: Limited Soil Excavation with Land Use Controls	• Future sampling to delineate the extent of soil exceedances at DU 3-1, 3-2, and 3-3 • Install erosion controls • Soil excavation at DU 3-2 and 3-3 to remove all soil exceeding the Industrial PRGs (including RIDEM GA Leachability Criteria) and Ecological PRG (DU 3-3 only) • Off-site disposal of excavated soils from both exposure areas • Backfill and site restoration • Implement LUCs restricting residential use at DU 3-1, 3-2, and 3-3 and perform associated inspections and reporting • Apply LUCs at DU 3-1 to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. • Apply LUCs at DU 3-3 to require maintenance of the ECH building foundation • Five-year reviews to evaluate remedy
S-3: Containment with Land Use Controls	• Future sampling to delineate the extent of soil exceedances at DU 3-1, 3-2, and 3-3 • Site preparation for containment at DU 3-2 and 3-3 • Install asphalt cover systems at DU 3-2 and 3-3 consisting of 4 inches of asphalt pavement overlying at least 6 inches of clean sub-base material to prevent direct contact, erosion, and transport of remaining soil exceeding Industrial PRGs and Ecological PRGs (DU 3-3 only) and to minimize future leaching of soil contaminants to groundwater. • Apply LUCs to DU 3-2 and 3-3 that restrict cover disturbance and require maintenance of the asphalt covers. Regular site inspections of the cover would also be performed to verify the continued maintenance of LUCs until the cleanup levels have been achieved. • LUCs would also be applied to DU 3-1, 3-2, and 3-3 preventing residential use and to DU 3-3 to require maintenance of the ECH building foundation. • Apply LUCs at DU 3-1 to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. Five-year reviews to evaluate remedy
S-4: Excavation and Off-Site Disposal to Residential PRGs	• Future sampling to delineate the extent of soil exceedances at DU 3-1, 3-2, and 3-3 • Install erosion controls • Soil excavation at DU 3-1, 3-2, and 3-3 to remove all soil exceeding the Residential, Industrial, and Ecological PRGs

Alternative	Key Components
	• Off-site disposal of excavated soils from all exposure areas • Backfill and site restoration • Implement LUCs at DU 3-3 only to require maintenance of the ECH building foundation since the soil beneath the structure has not been assessed.
S-5: In Situ Thermal Desorption	• Future sampling to delineate the extent of soil exceedances at DU 3-1, 3-2, and 3-3 • Site preparation including erosion controls installation • Perform in situ thermal desorption system at DU 3-2 and 3-3 to address Industrial PRG exceedances for PAHs and PCBs, respectively. • Site restoration • Implement LUCs restricting residential use at DU 3-1, 3-2, and 3-3 and requiring maintenance of the ECH building foundation at DU 3-3 and perform associated inspections and reporting • Apply LUCs at DU 3-1 to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG. • Five-year reviews to evaluate remedy

Note: At locations where TPH exceedances are co-located with PRG exceedances for CERCLA contaminants, the CERCLA response action will address TPH as well. The Navy will handle residual TPH under the RIDEM UST and remediation regulations.

Table 3-2
Screening of Remedial Alternative S-1: No Action

Description: No remedial activities are included under this alternative.

	Effectiveness	Implementability	Cost
Advantages:	• None	• No action makes this the easiest alternative to implement	• No capital costs • No O&M costs
Disadvantages:	• Does not mitigate on-site risk to residential, industrial, and ecological receptors, or address exceedances of the RIDEM GA Leachability Criteria	• Additional remedial actions may be required in the future	• Costs of additional remedial actions (if required)

Conclusion: The No Action alternative is not protective of the environment. However, it is used as a baseline in comparison with other alternatives. This alternative will be retained for detailed analysis.

Table 3-3
Screening of Remedial Alternative S-2: Limited Soil Excavation with Land Use Controls

Description: Under this alternative, soil excavation and off-site disposal of soil at DU 3-2 and 3-3 would be conducted to meet the Industrial PRGs (including RIDEM GA Leachability Criteria) and Ecological PRG for DU 3-3. LUCs would be established at DU 3-1, 3-2, and 3-3 and inspections would be conducted to prevent residential use. LUCs would also be needed at DU 3-3 to require maintenance of the ECH building foundation, since the soil beneath the structure has not been assessed. If the building is demolished in the future, the underlying soil would be assessed and remediated, if needed, to meet industrial and ecological PRGs.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG.

At locations where TPH exceedances are co-located with PRG exceedances for CERCLA contaminants, the CERCLA response action will address TPH as well. The Navy will handle residual TPH under the RIDEM UST and remediation regulations.

	Effectiveness	Implementability	Cost
Advantages:	• Removes soil exceeding the Industrial PRGs (including RIDEM GA Leachability Criteria) at DU 3-2 and 3-3 and Ecological PRG at DU 3-3	• LUCs and soil excavations are proven technologies and easy to implement.	• Low capital costs • Low O&M costs
Disadvantages:	• Does not remove all contaminants • Limits use of property for residential uses	• Long-term actions are required	• Five-year Review costs

Conclusion: The Limited Soil Excavation with Land Use Controls alternative is protective of human health and the environment. This alternative is less difficult to implement than other alternatives. This alternative will be retained for detailed analysis.

Table 3-4
Screening of Remedial Alternative S-3: Containment with Land Use Controls

Description: This alternative would use asphalt covers to provide a barrier to the contaminated soils in excess of Industrial PRGs (including RIDEM GA Leachability Criteria) and Ecological PRGs (applicable to DU 3-3 only). This containment system would also minimize future leaching of PAHs and PCBs from soil to groundwater. LUCs at the DU 3-2 and 3-3 would restrict cover disturbance and require maintenance of the asphalt covers as well as perform associated inspections and reporting. LUCs would also be applied to DU 3-1, 3-2, and 3-3 preventing residential use and LUCs would be needed at DU 3-3 to require maintenance of the ECH building foundation, since the soil beneath the structure has not been assessed. If the building is demolished in the future, the underlying soil would be assessed and remediated, if needed, to meet industrial and ecological PRGs.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG.

At locations where TPH exceedances are co-located with PRG exceedances for CERCLA contaminants, the CERCLA response action will address TPH as well. The Navy will handle residual TPH under the RIDEM UST and remediation regulations.

	Effectiveness	Implementability	Cost
Advantages:	• Eliminates exposure to contaminated soils	• An asphalt cover is a proven technology	• Low capital costs
Disadvantages:	• Does not remove all contaminants	• Maintenance will be required	• Moderate O&M cost • Five-year Review costs

Conclusion: The Containment with Land Use Controls alternative is protective of human health and the environment. However, maintenance of the asphalt cover will be required since contaminants remain in place. This alternative will be retained for detailed analysis.

Table 3-5
Screening of Remedial Alternative S-4: Excavation and Off-Site Disposal to Residential PRGs

Description: Under this alternative, contaminated soil from DU 3-1, 3-2, and 3-3 will be excavated and disposed off-site. This alternative would address all soils exceeding selected PRGs at DU 3-1 and DU 3-2. LUCs would be needed at DU 3-3 to require maintenance of the ECH building foundation, since the soil beneath the structure has not been assessed. If the ECH building is demolished in the future, the presence or absence of soil beneath the building would be assessed and if soil is present, it would be remediated, if necessary, to meet Residential, Industrial and Ecological PRGs. Demolition of this building is not considered part of the remedy.

At locations where TPH exceedances are co-located with PRG exceedances for CERCLA contaminants, the CERCLA response action will address TPH as well. The Navy will handle residual TPH under the RIDEM UST and remediation regulations.

	Effectiveness	Implementability	Cost
Advantages:	• Removes contaminated soil	• Excavation is a proven technology	• Limited O&M costs
Disadvantages:	• Transportation to off-site facilities increases the potential for current and future liability	• Moderate amount of logistical considerations required during excavation	• Moderate capital cost

Conclusion: The Excavation and Off-Site Disposal to Residential PRGs alternative is protective of human health and the environment. This alternative has a limited benefit (small area that would be made available for unlimited use/unrestricted exposure) as compared to the cost of remediation as well as the anticipated future land use (i.e., industrial). This alternative will not be retained for detailed analysis.

Table 3-6
Screening of Remedial Alternative S-5: In Situ Thermal Desorption

Description: This alternative would include in situ remediation to treat PCB and PAH contamination in soil at DU 3-3 and 3-2, respectively. LUCs would be established at DU 3-1, 3-2, and 3-3 and inspections would be conducted to prevent residential use. LUCs would also be needed at DU 3-3 to require maintenance of the ECH building foundation, since the soil beneath the structure has not been assessed. If the building is demolished in the future, the underlying soil would be assessed and remediated, if needed, to meet industrial and ecological PRGs.

At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG.

At locations where TPH exceedances are co-located with PRG exceedances for CERCLA contaminants, the CERCLA response action will address TPH as well. The Navy will handle residual TPH under the RIDEM UST and remediation regulations.

	Effectiveness	Implementability	Cost
Advantages:	• Eliminates exposure to contaminated soils	• In situ remediation is a proven technology	• None
Disadvantages:	• Does not remove all contaminants	• Large amount of logistical considerations	• High capital cost • Five-year Review costs

Conclusion: The In Situ Thermal Desorption alternative is protective of human health and the environment. This remedial alternative has the highest cost and limited benefit as compared to the cost of remediation. This alternative will not be retained for detailed analysis.

Table 4-1
Detailed Evaluation of S-1: No Action

Evaluation Criteria	Detailed Analysis
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	
Human Health Protection	This alternative would not provide any protection of human health from risks identified at DU 3-1, 3-2, and 3-3 in the DGA Report.
Ecological Protection	This alternative would not provide any protection of the environment from risks assumed at DU 3-3 in the DGA Report.
COMPLIANCE WITH ARARs	
Chemical-, Location-, and Action-Specific	Under current conditions, chemical-specific ARARs have not been met. Therefore, this alternative would not meet ARARs. Refer to Table B-1 in Appendix B for a list and evaluation of ARARs associated with this alternative.
LONG-TERM EFFECTIVENESS AND PERMANENCE	
Magnitude of Residual Risk	Since this alternative includes no controls to reduce potential direct contact with contaminated soil, the residual risk would be the same as that identified in the DGA Report.
Adequacy and Reliability of Controls	This alternative does not include any controls to reduce potential future exposures to soil.
REDUCTION OF TMV THROUGH TREATMENT	
Treatment Process Used and Materials Treated	No treatment would be performed under this alternative.
Amount Destroyed or Treated	No treatment would be performed under this alternative.
Degree of Expected Reductions of TMV through treatment	No treatment would be performed under this alternative.
Degree to which Treatment is Irreversible	No treatment would be performed under this alternative.
Type and Quantity of Residuals Remaining after Treatment	No treatment would be performed under this alternative.
SHORT-TERM EFFECTIVENESS	
Protection of Community during Remedial Actions	Since this alternative involves no construction or monitoring measures, there would be no additional short-term risks to the community from the remedy.
Protection of Workers during Remedial Actions	Since this alternative involves no construction or monitoring measures, there would be no additional short-term risks to workers from the remedy.
Environmental Impacts	Since this alternative involves no construction or monitoring measures, there would be no additional short-term environmental impacts associated with the remedy.

Evaluation Criteria	Detailed Analysis
Time to Achieve Remedial Action Objectives	This alternative does not meet RAOs
IMPLEMENTABILITY	
Ability to Construct and Operate	No construction or operation would be performed under this alternative.
Reliability of the Technology	No technologies would be implemented under this alternative.
Ease of undertaking Additional Remedial Actions, if needed	If further action is deemed necessary in the future, this alternative would allow for additional remedial actions to occur.
Ability to Monitor Effectiveness	No monitoring would be conducted under this alternative. Therefore, the effectiveness would not be evaluated.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approvals would likely be needed for this alternative.
Availability of Off-Site Treatment, Storage, and Disposal Services and Capacity	No off-site treatment, storage, or disposal services would be needed under this alternative.
Availability of Necessary Equipment and Specialists	No equipment or specialists would be needed under this alternative.
Availability of Technology	No technologies would be needed for this alternative.
COSTS	
Total Cost	$0

Table 4-2

Detailed Evaluation of S-2: Limited Soil Excavation with Land Use Controls

Evaluation Criteria	Detailed Analysis
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	
Human Health Protection	This alternative removes soil concentrations exceeding the Industrial PRGs (including RIDEM GA Leachability Criteria) at DU 3-2 and 3-3; thereby, reducing the risk to industrial workers. LUCs at DU 3-1, 3-2, and 3-3 would prevent residential use of the property so that contact with COCs at concentrations that would cause an unacceptable risk to human receptors is prevented for the life of the remedy. LUCs would also be needed at DU 3-3 to require maintenance of the ECH building foundation, since the soil beneath the building has not been assessed. At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG.
Ecological Protection	Soil exceeding the Ecological PRG would be removed from DU 3-3; thereby, reducing the risk to ecological receptors.
COMPLIANCE WITH ARARs	
Chemical-, Location-, and Action-Specific	Under this alternative, chemical-specific and action-specific ARARs will be met. Therefore this alternative would meet ARARs. Refer to Tables B-2a, B-2b, and B-2c in Appendix B for a list and evaluation of ARARs associated with this alternative.
LONG-TERM EFFECTIVENESS AND PERMANENCE	
Magnitude of Residual Risk	Under this alternative, risks to industrial users and ecological receptors would be reduced to acceptable levels through contamination removal. Risks to residential users would be reduced by restricting access. The type and quantity of contaminants remaining at DU 3-1 following implementation of this limited action remedy is the same as current conditions. The type and quantity of contaminants remaining at DU 3-2 and 3-3 following implementation of this limited action remedy is slightly less than current conditions. LUCs would be implemented at DU 3-1, 3-2, and 3-3 to restrict residential use that could pose unacceptable exposure.
Adequacy and Reliability of Controls	Adequacy of this alternative will be confirmed during the five-year reviews. LUCs are reliable if properly enforced.
REDUCTION OF TMV THROUGH TREATMENT	
Treatment Process Used and Materials	No treatment would be performed under this alternative.

Evaluation Criteria	Detailed Analysis
Treated	
Amount Destroyed or Treated	No treatment would be performed under this alternative.
Degree of Expected Reductions of TMV through treatment	No treatment would be performed under this alternative.
Degree to which Treatment is Irreversible	No treatment would be performed under this alternative.
Type and Quantity of Residuals Remaining after Treatment	No treatment would be performed under this alternative.
SHORT-TERM EFFECTIVENESS	
Protection of Community during Remedial Actions	Short-term community risks associated with off-site disposal of contaminated soil would be minor.
Protection of Workers during Remedial Actions	Short-term worker risks associated with environmental sampling and excavation would be mitigated through the use of proper PPE.
Environmental Impacts	Short-term, minor impacts to ecological habitat due to excavation and environmental sampling would occur.
Time to Achieve Remedial Action Objectives	RAOs would be achieved once the limited excavation is performed and LUCs are implemented. It is assumed implementation of this alternative will take approximately 1 year.
IMPLEMENTABILITY	
Ability to Construct and Operate	LUCs and excavation are common and easy to implement.
Reliability of the Technology	Excavation and LUCs are known to be reliable.
Ease of undertaking Additional Remedial Actions, if needed	If further action is deemed necessary in the future, this alternative would allow for additional remedial actions to occur.
Ability to Monitor Effectiveness	Additional sampling would be performed to identify the extent of contamination to ensure the initial effectiveness of the excavation and LUCs. Five-year reviews will also be conducted to monitor effectiveness.
Ability to Obtain Approvals and Coordinate with Other Agencies	Approval for disposal of contaminated soils would require coordination with other agencies.
Availability of Off-Site Treatment, Storage, and Disposal Services and Capacity	Multiple facilities would be able to accept the excavated materials for final disposition.
Availability of Necessary Equipment and Specialists	There are many contractors available to provide the equipment and services required by this alternative.
Availability of Technology	This alternative contains commonly-used technologies.

Evaluation Criteria	Detailed Analysis
COSTS	
Capital Costs	$368,759
O&M	$92,461
Five-Year Reviews	$23,307
Total Cost[1]	$485,000

[1] Rounded to the nearest $1,000

Table 4-3
Detailed Evaluation of S-3: Containment with Land Use Controls

Evaluation Criteria	Detailed Analysis
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	
Human Health Protection	This alternative prevents direct contact, erosion, and transport of soil exceeding the Industrial PRGs (including RIDEM GA Leachability Criteria) at DU 3-2 and 3-3. This containment system would also minimize future leaching of PAHs and PCBs from soil to groundwater. LUCs would be implemented at DU 3-2 and 3-3 so that the asphalt cover remains intact as so that the ECH building foundation at DU 3-3 is maintained, since the soil beneath the structure has not been assessed. LUCs would also be applied to DU 3-1, 3-2, and 3-3 preventing residential use so that contact with COCs at concentrations that would cause an unacceptable risk to human receptors is prevented for the life of the remedy. At DU 3-1, LUCs would also be established to assure that at least two feet of surface soil (0-2 feet), which contains arsenic below the Industrial PRG, remains undisturbed in the area within DU 3-1 where subsurface soil exceeds the Industrial PRG.
Ecological Protection	This alternative prevents direct contact, erosion, and transport of soil exceeding the Ecological PRG at DU 3-3.
COMPLIANCE WITH ARARs	
Chemical-, Location-, and Action-Specific	Under this alternative, chemical-specific and action-specific ARARs will be met. Therefore this alternative would meet ARARs. Refer to Tables B-3a, B-3b, and B-3c in Appendix B for a list and evaluation of ARARs associated with this alternative.
LONG-TERM EFFECTIVENESS AND PERMANENCE	
Magnitude of Residual Risk	Under this alternative, risks to industrial users and ecological receptors would be reduced to acceptable levels through installation of an asphalt cover. Risks to residential users would be reduced by restricting access. The type and quantity of contaminants remaining at the site following implementation of this remedy is the same as current conditions. Exposure to the COCs at DU 3-2 and 3-3 would be prevented by the asphalt cover. LUCs would be implemented to ensure the integrity of the cover at the DU 3-2 and 3-3 and to maintain the building foundation at DU 3-3. LUCs would also be implemented at DU 3-1, 3-2, and 3-3 to restrict use that could pose unacceptable exposure. The installation of an asphalt cover would impact the ecological habitat. However, this impact would only affect a small area.

Evaluation Criteria	Detailed Analysis
Adequacy and Reliability of Controls	Adequacy of this alternative will be confirmed during the five-year reviews. LUCs are reliable if properly enforced.
REDUCTION OF TMV THROUGH TREATMENT	
Treatment Process Used and Materials Treated	No treatment would be performed under this alternative.
Amount Destroyed or Treated	No treatment would be performed under this alternative.
Degree of Expected Reductions of TMV through treatment	No treatment would be performed under this alternative.
Degree to which Treatment is Irreversible	No treatment would be performed under this alternative.
Type and Quantity of Residuals Remaining after Treatment	No treatment would be performed under this alternative.
SHORT-TERM EFFECTIVENESS	
Protection of Community during Remedial Actions	Short-term community risks associated with the truck deliveries during cover installation would be minor.
Protection of Workers during Remedial Actions	Short-term worker risks associated with environmental sampling and cover installation would be mitigated through the use of proper PPE.
Environmental Impacts	Impacts to ecological habitat due to cover installation and environmental sampling would occur.
Time to Achieve Remedial Action Objectives	RAOs would be achieved once the cover installation is complete and LUCs are implemented. It is assumed implementation of this alternative will take approximately 1 year.
IMPLEMENTABILITY	
Ability to Construct and Operate	LUCs and impermeable covers are common technologies. With the proper planning and design, the alternative would be relatively easy to implement.
Reliability of the Technology	Asphalt covers and LUCs are known to be reliable.
Ease of undertaking Additional Remedial Actions, if needed	If further action is deemed necessary in the future, the asphalt cover would have to be removed in order to allow for additional remedial actions.
Ability to Monitor Effectiveness	Additional sampling would be performed to identify the extent of contamination to insure the initial effectiveness of the cover and LUCs. Inspections and five-year reviews will be conducted to monitor the effectiveness of the remedy.
Ability to Obtain Approvals and Coordinate with Other Agencies	Approval of asphalt cover design would require coordination with other agencies.
Availability of Off-Site Treatment, Storage, and Disposal Services and Capacity	No off-site treatment, storage, or disposal services would be needed under this alternative.
Availability of Necessary Equipment and Specialists	There are many contractors available to provide the equipment and services required by this alternative.

Evaluation Criteria	Detailed Analysis
Availability of Technology	This alternative contains commonly-used technologies.
COSTS	
Capital Costs	$369,709
O&M	$105,670
Five-Year Reviews	$23,307
Total Cost[1]	$499,000

[1] Rounded to the nearest $1,000

Table 5-1
Cost Sensitivity Analysis Summary

Cost Estimate Scenarios	Alternative S-2	Alternative S-3
	Limited Soil Excavation with Land Use Controls	Containment with Land Use Controls
Lower-end cost projection[(1)]	$370,000	$376,000
Baseline cost estimate[(2)]	$485,000	$499,000
Upper-end cost projection[(3)]	$630,000	$635,000

Notes:
(1) Cost rounded to nearest $1,000. Eliminate contingency costs; apply a 25% reduction to O&M and Five-Year Review costs
(2) Cost rounded to nearest $1,000. Cost estimate as provided in the baseline alternative (Appendix C)
(3) Cost rounded to nearest $1,000. Cost estimates expanded as follows:

Alternative S-2: Double the area and volume of limited excavation from 60 cubic yards to 120 cubic yards; increase number of delineation samples by 20%; increase number of waste characterization samples to 2 samples (1 sample per 100 cubic yards); increase data validation hours to 70; increase cost of annual LUC site inspection by 20%

Alternative S-3: Double the area of the asphalt cover from 325 square feet to 650 square feet; increase number of delineation samples by 20%; increase data validation hours to 70; increase cost of annual LUC site inspection by 20%

Figures

RESOLUTION CONSULTANTS

Drawn:	JB	10/21/2015
Approved:	MK	10/21/2015
Project #:	60268619	

Map Location

N
0 1,200 2,400
Scale in Feet

FIGURE 1
SITE MAP

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_1_Site_Map.mxd

RESOLUTION CONSULTANTS

Drawn: JB 05/16/2016

Approved: MK 05/16/2016

Project #: 60266436

N

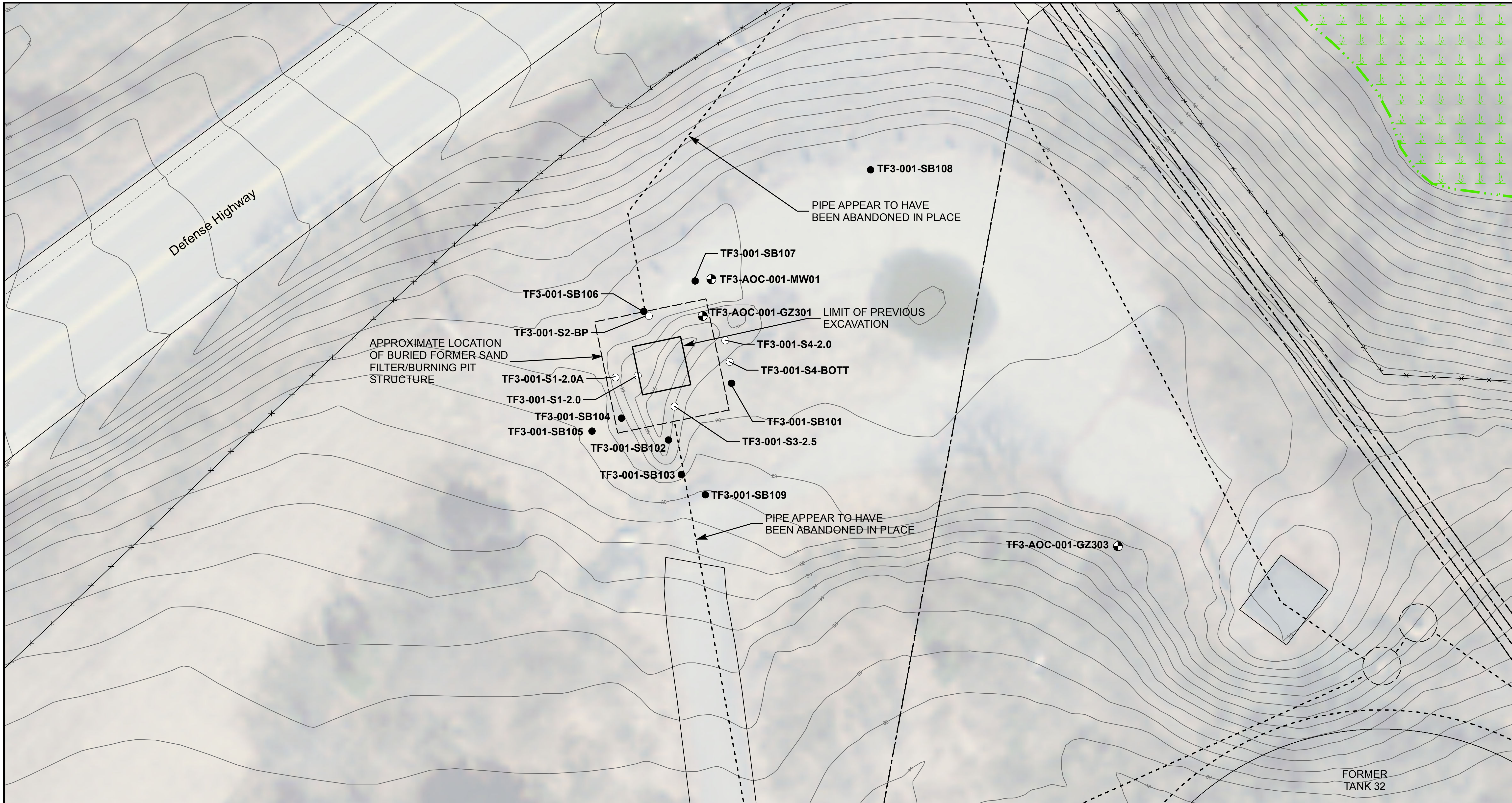
0 100 200

Scale in Feet

FIGURE 2
TANK FARM 3 LAYOUT

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_2_Site_11_Tank_Farm_3_Layout.mxd



RESOLUTION CONSULTANTS

Drawn:	JB	04/06/2016
Approved:	MK	04/06/2016
Project #:	60266436	

Legend

- Monitoring Well Location
- Sample Point Location (2004)
- Soil Sample Location (2013)
- Site 11 Boundary
- Wetland
- Topographic Contour Line (NAVD 88)
- Petroleum Distribution (Remaining)
- Ring Drain/BSW Drainage (Remaining)

N

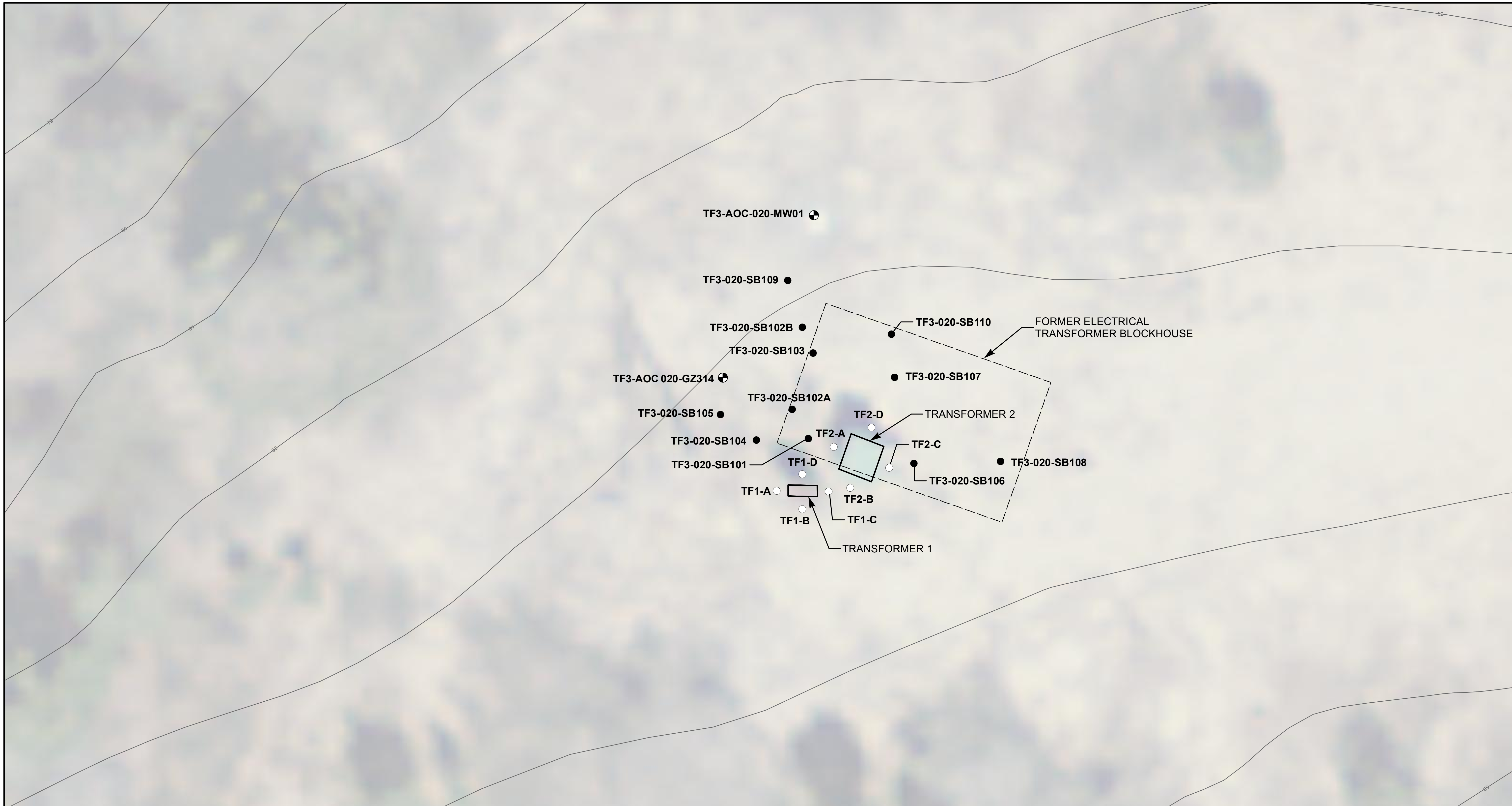
0 10 20

Scale in Feet

FIGURE 3
SOIL SAMPLE LOCATIONS - DECISION UNIT 3-1

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_3_Site_11_TF3_Soil and GW Samples_DU3_1.mxd



RESOLUTION CONSULTANTS

Drawn: JB 10/21/2015

Approved: MK 10/21/2015

Project #: 60266436

Legend

- Monitoring Well Location
- Sample Point Location (2004)
- Soil Boring Location (2013)
- Existing Structure

N

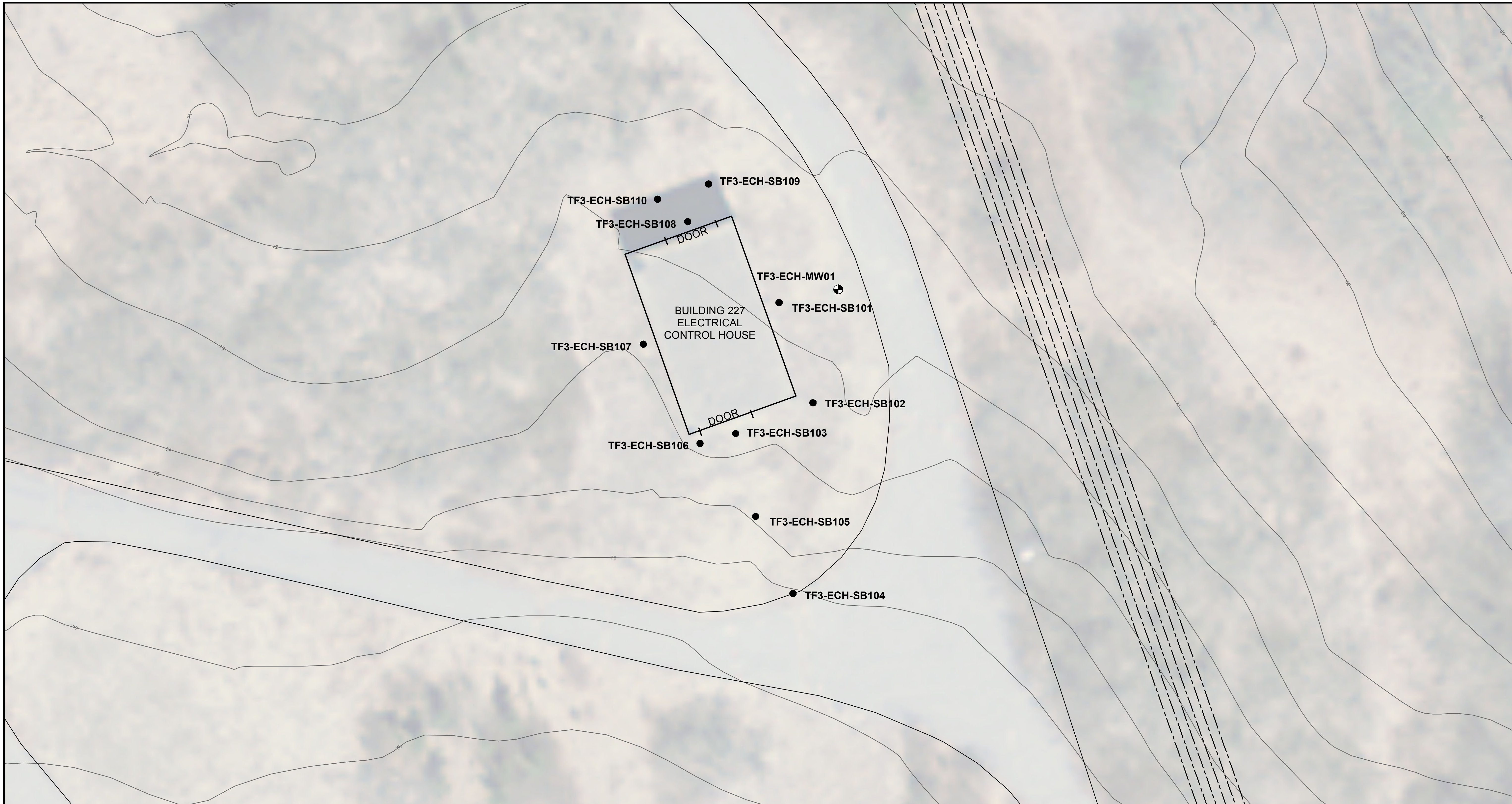
0 5 10

Scale in Feet

FIGURE 4
SOIL SAMPLE LOCATIONS - DECISION UNIT 3-2

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_4_Site_11_TF3_Sample_Locations_DU3_2.mxd



RESOLUTION CONSULTANTS

Drawn:	JB	10/21/2015
Approved:	MK	10/21/2015
Project #:	60266436	

Legend

- Monitoring Well Location
- Soil Boring Location (2013)
- Petroleum Distribution (Remaining)
- Existing Structure

N

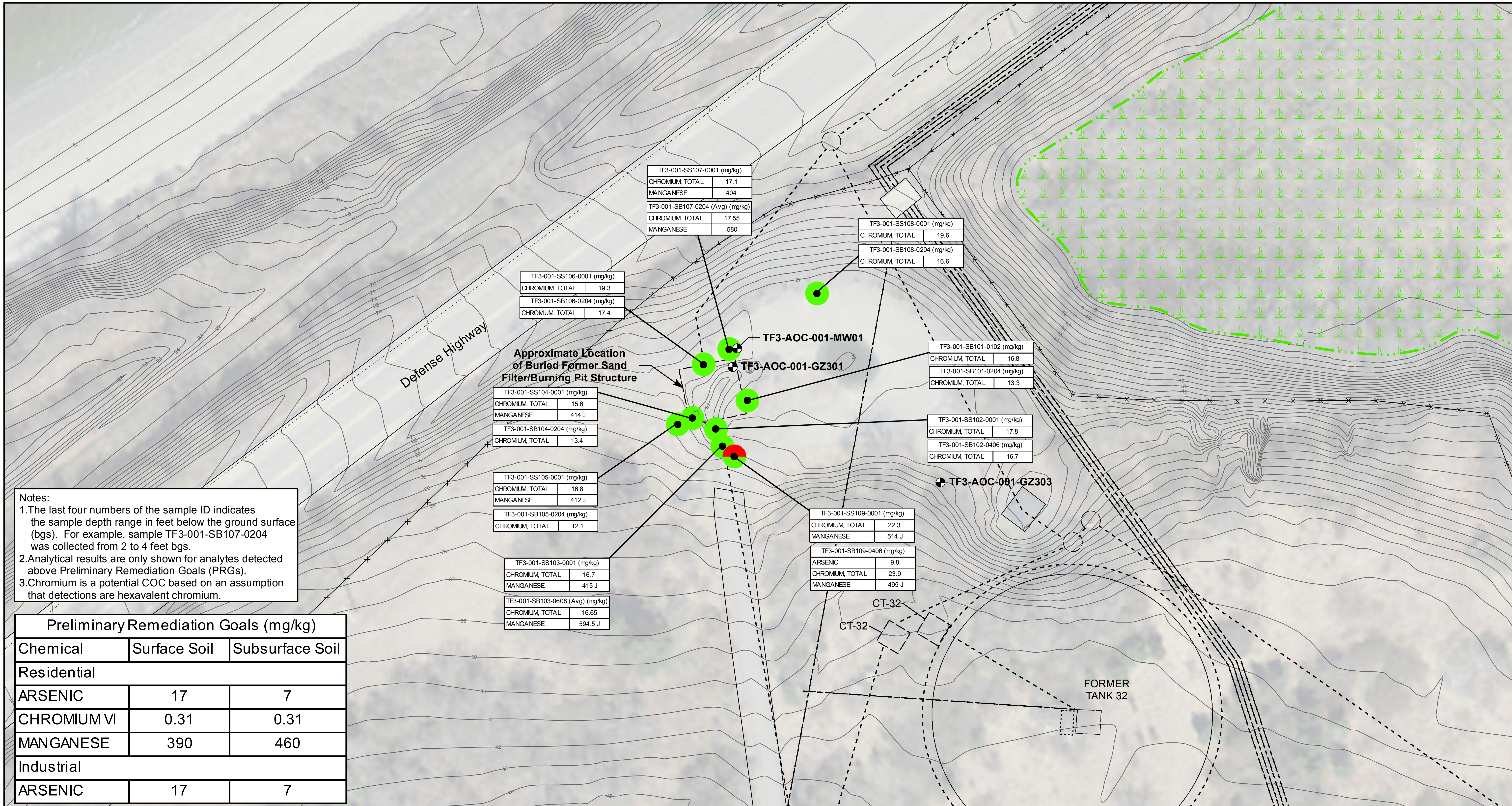
0 10 20

Scale in Feet

FIGURE 5
SOIL SAMPLE LOCATIONS - DECISION UNIT 3-3

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_5_Site_11_TF3_Soil_and_GW_Samples_ECH_Area.mxd



Notes:
1. The last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. Chromium is a potential COC based on an assumption that detections are hexavalent chromium.

Preliminary Remediation Goals (mg/kg)		
Chemical	Surface Soil	Subsurface Soil
Residential		
ARSENIC	17	7
CHROMIUM VI	0.31	0.31
MANGANESE	390	460
Industrial		
ARSENIC	17	7

RESOLUTION CONSULTANTS

Drawn: JB 08/09/2016
Approved: MK 08/09/2016
Project #: 60268619

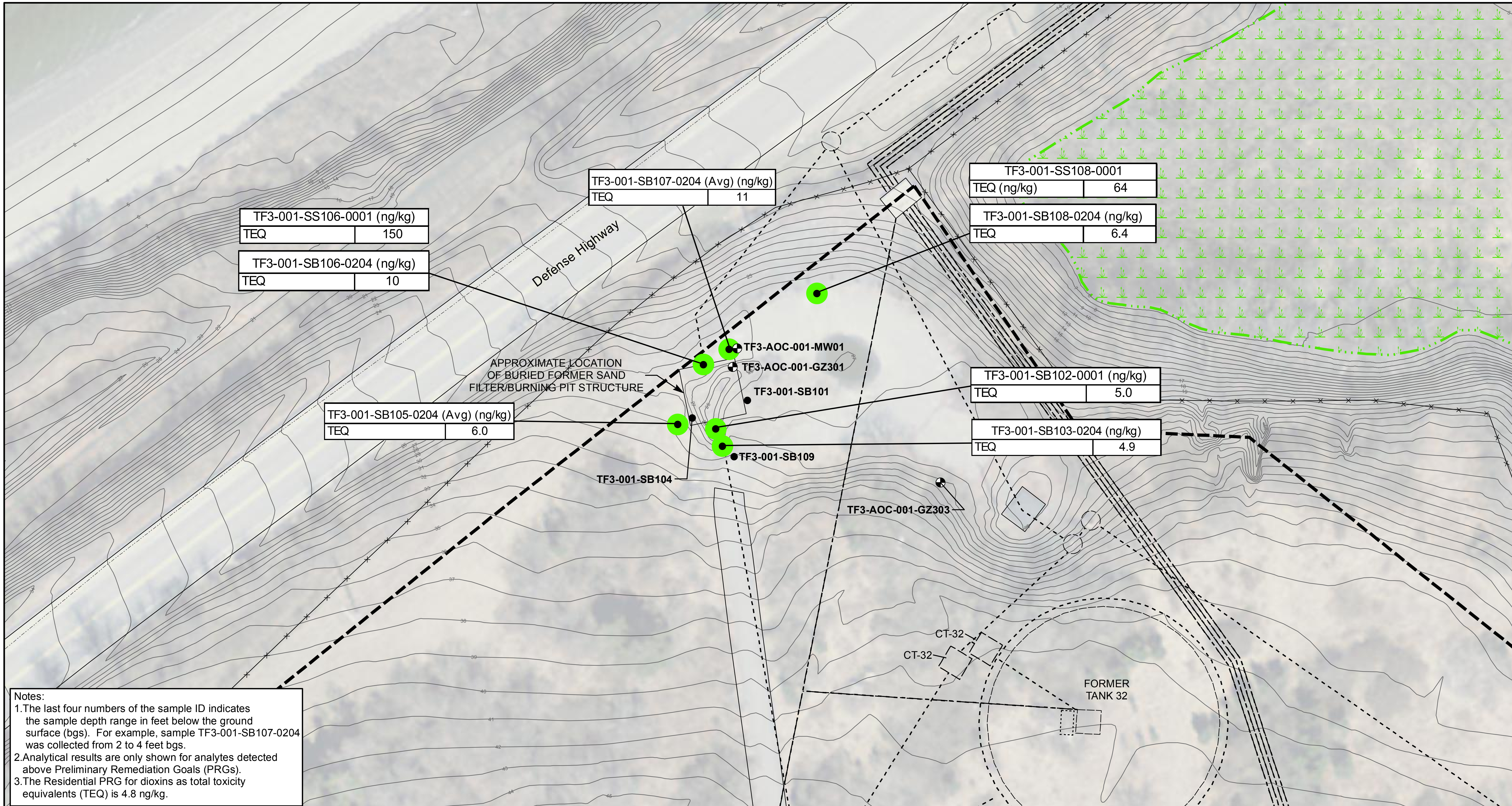
Legend
- Monitoring Well Location
- Soil Sample Location (2013)
- Residential PRG Exceedance
- Industrial PRG Exceedance
- Site 11 Boundary
- Wetland
- Topographic Contour Line (NAVD 88)
- Petroleum Distribution (Remaining)
- Ring Drain/BSW Drainage (Remaining)

N
0 20 40
Scale in Feet

FIGURE 6
SOILS EXCEEDING PRGS FOR METALS - DECISION UNIT 3-1

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_6_Site_11_TF3_Soil Exceeding PRGs_Metals_DU3_1.mxd



Notes:
1. The last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. The Residential PRG for dioxins as total toxicity equivalents (TEQ) is 4.8 ng/kg.

RESOLUTION CONSULTANTS

Drawn: JB 10/21/2015
Approved: MK 10/21/2015
Project #: 60266436

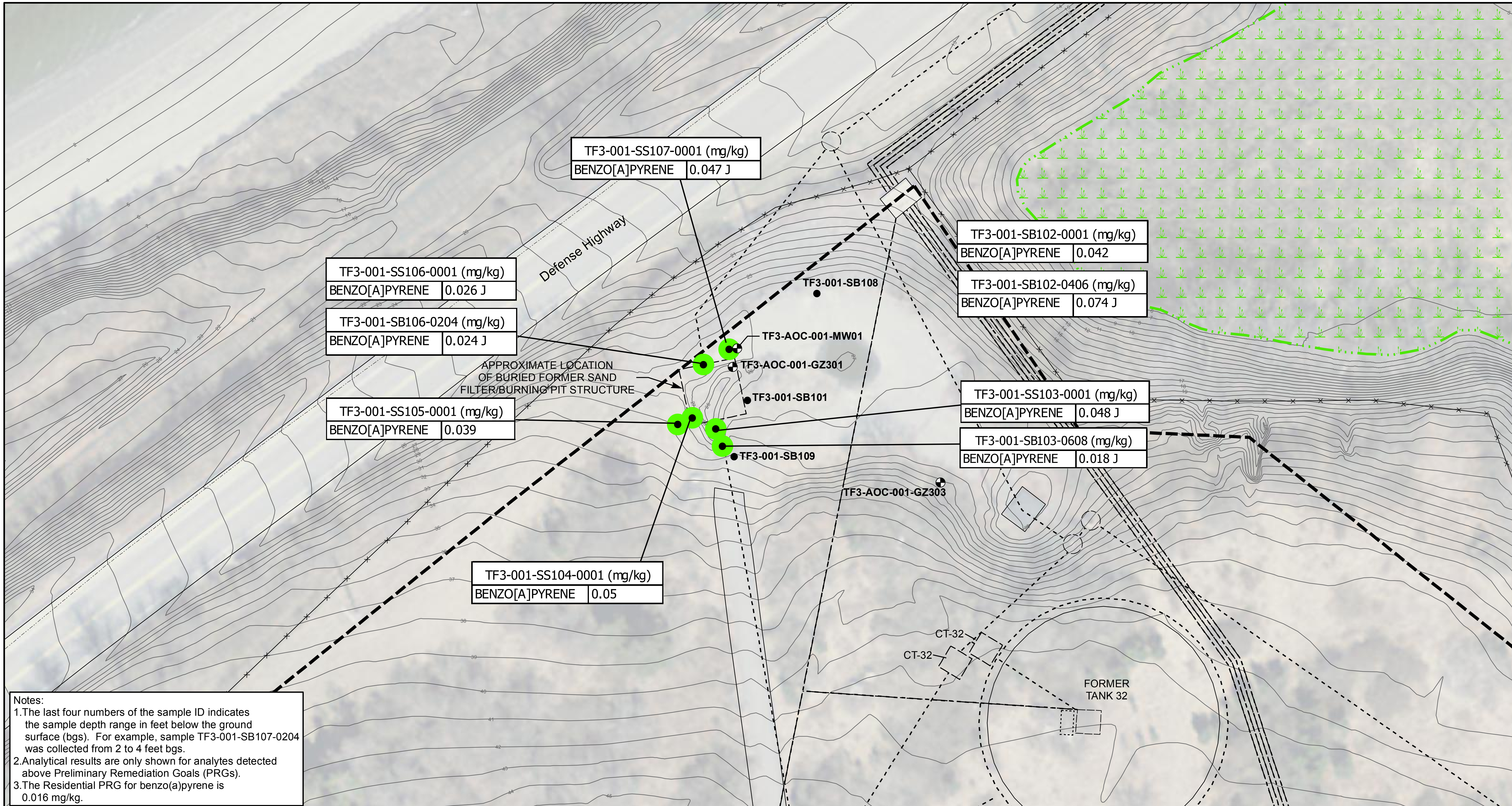
Legend
- Monitoring Well Location
- Soil Sample Location (2013)
- Residential PRG Exceedance
- Site 11 Boundary
- Wetland
- Petroleum Distribution (Remaining)
- Ring Drain/BSW Drainage (Remaining)

N
0 20 40
Scale in Feet

FIGURE 7
SOILS EXCEEDING RESIDENTIAL PRGS FOR DIOXINS - DECISION UNIT 3-1

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_7_Site_11_TF3_Soil Exceeding PRGs_Dioxins_DU3_1.mxd



Notes:
1. The last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. The Residential PRG for benzo(a)pyrene is 0.016 mg/kg.

RESOLUTION CONSULTANTS

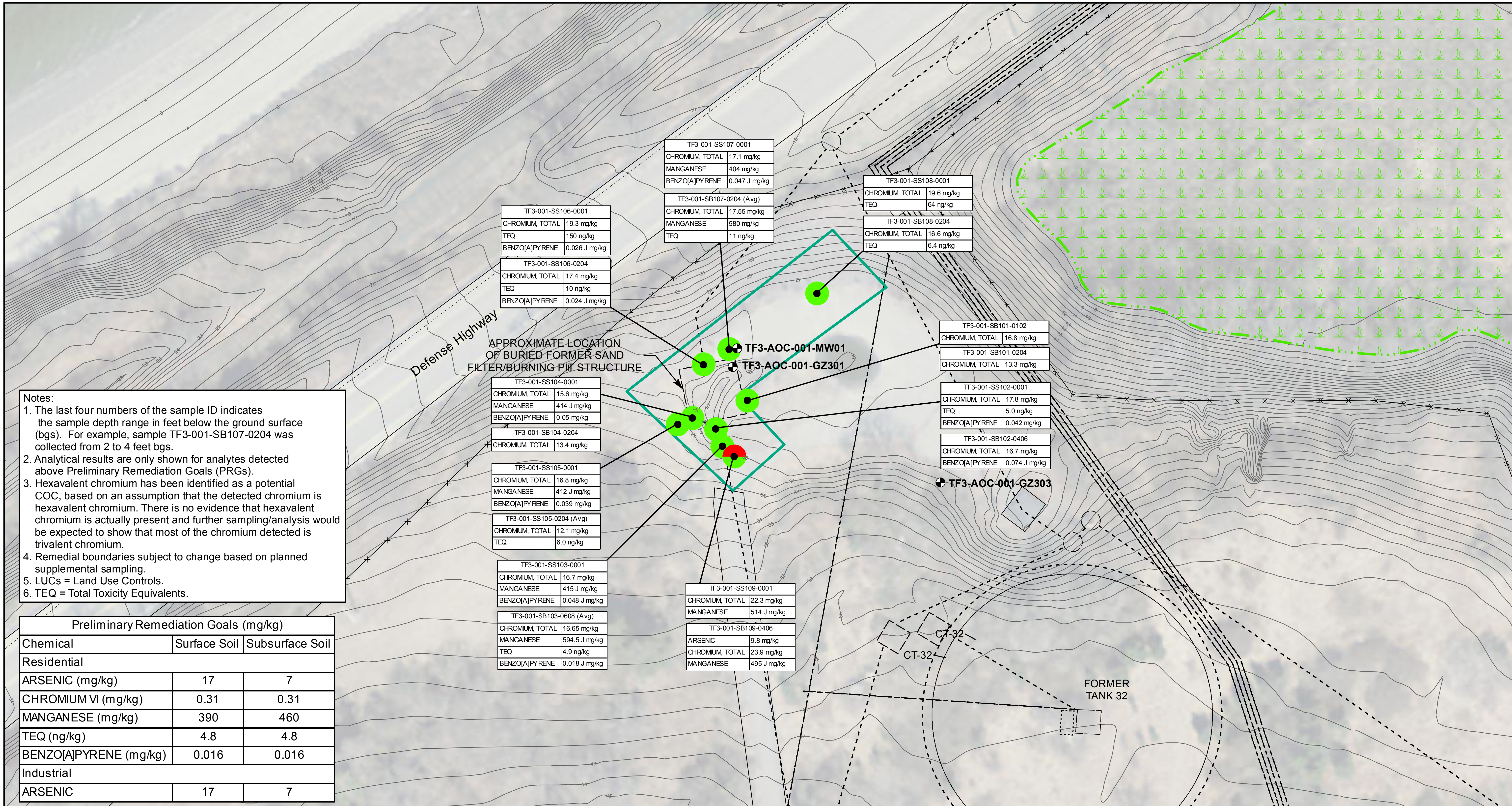
Drawn: JB 10/21/2015
Approved: MK 10/21/2015
Project #: 60266436

Legend
- Monitoring Well Location
- Soil Sample Location (2013)
- Residential PRG Exceedance
- Site 11 Boundary
- Wetland
- Petroleum Distribution (Remaining)
- Ring Drain/BSW Drainage (Remaining)

N
0 20 40
Scale in Feet

FIGURE 8
SOILS EXCEEDING RESIDENTIAL PRGS FOR PAHS -DECISION UNIT 3-1
SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_8_Site_11_TF3_Soil and GW Samples_DU3_1.mxd



Notes:
1. The last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. Hexavalent chromium has been identified as a potential COC, based on an assumption that the detected chromium is hexavalent chromium. There is no evidence that hexavalent chromium is actually present and further sampling/analysis would be expected to show that most of the chromium detected is trivalent chromium.
4. Remedial boundaries subject to change based on planned supplemental sampling.
5. LUCs = Land Use Controls.
6. TEQ = Total Toxicity Equivalents.

Preliminary Remediation Goals (mg/kg)		
Chemical	Surface Soil	Subsurface Soil
Residential		
ARSENIC (mg/kg)	17	7
CHROMIUM VI (mg/kg)	0.31	0.31
MANGANESE (mg/kg)	390	460
TEQ (ng/kg)	4.8	4.8
BENZO[A]PYRENE (mg/kg)	0.016	0.016
Industrial		
ARSENIC	17	7

RESOLUTION CONSULTANTS

Drawn: JB 08/09/2016
Approved: MK 08/09/2016
Project #: 60268619

Legend
- Monitoring Well Location
- Soil Sample Location (2013)
- Residential PRG Exceedance
- Industrial PRG Exceedance
- Site 11 Boundary
- Estimated Extent LUCs
- Wetland
- Topographic Contour Line (NAVD 88)
- Petroleum Distribution (Remaining)
- Ring Drain/BSW Drainage (Remaining)

N

0 20 40
Scale in Feet

FIGURE 9
SUMMARY OF SOILS EXCEEDING RESIDENTIAL PRGS - DECISION UNIT 3-1

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

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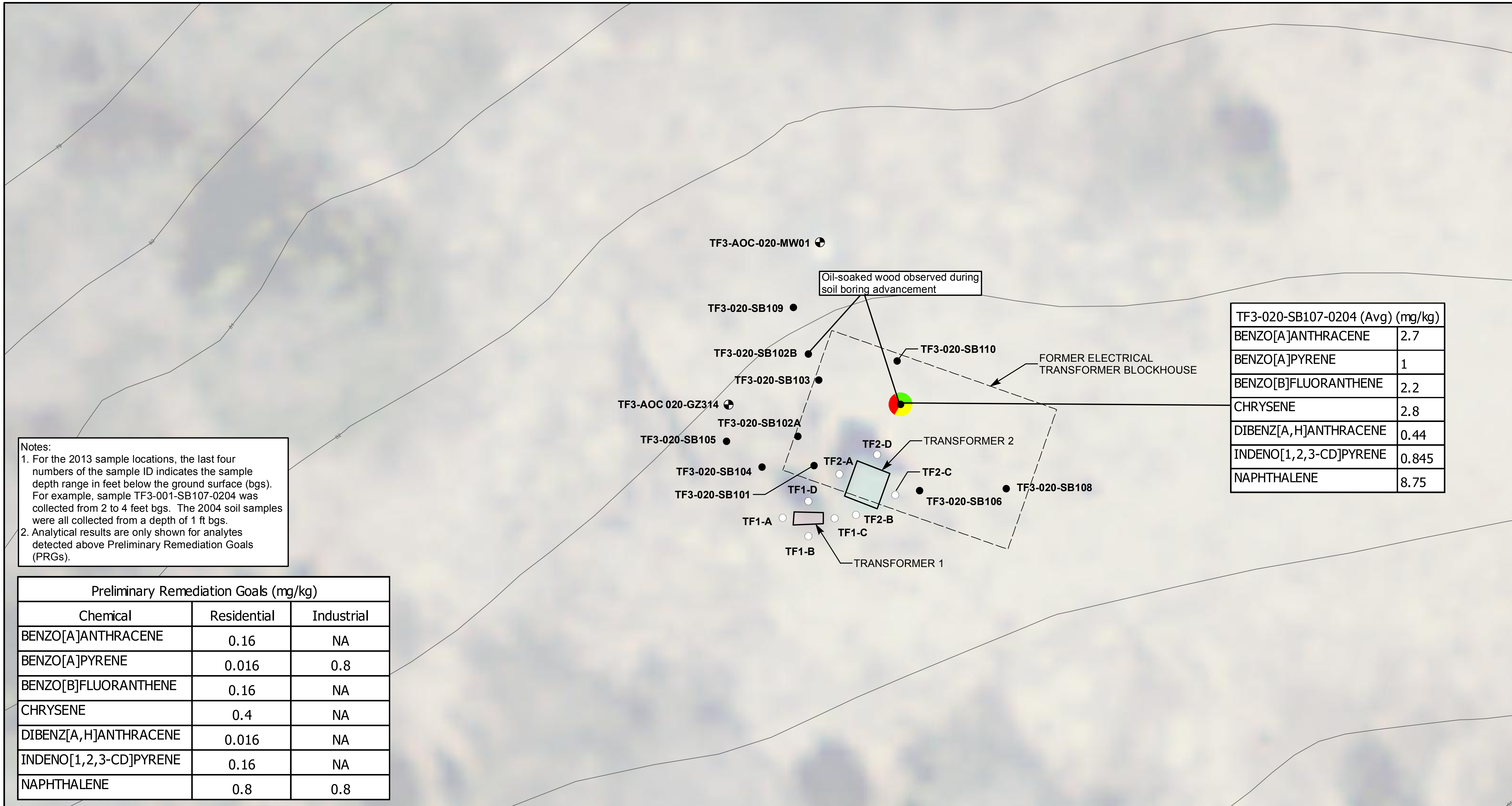


TF3-020-SB107-0204 (Avg) (mg/kg)	
BENZO[A]ANTHRACENE	2.7
BENZO[A]PYRENE	1
BENZO[B]FLUORANTHENE	2.2
CHRYSENE	2.8
DIBENZ[A,H]ANTHRACENE	0.44
INDENO[1,2,3-CD]PYRENE	0.845
NAPHTHALENE	8.75

Notes:
1. For the 2013 sample locations, the last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs. The 2004 soil samples were all collected from a depth of 1 ft bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).

Preliminary Remediation Goals (mg/kg)		
Chemical	Residential	Industrial
BENZO[A]ANTHRACENE	0.16	NA
BENZO[A]PYRENE	0.016	0.8
BENZO[B]FLUORANTHENE	0.16	NA
CHRYSENE	0.4	NA
DIBENZ[A,H]ANTHRACENE	0.016	NA
INDENO[1,2,3-CD]PYRENE	0.16	NA
NAPHTHALENE	0.8	0.8

RESOLUTION CONSULTANTS

Drawn: JB 10/21/2015
Approved: MK 10/21/2015
Project #: 60268619

Legend
- Monitoring Well Location
- Sample Point Location (2004)
- Soil Boring Location (2013)
- RIDEM GA Leachability Exceedance
- Industrial PRG Exceedance
- Residential PRG Exceedance
- Existing Structure

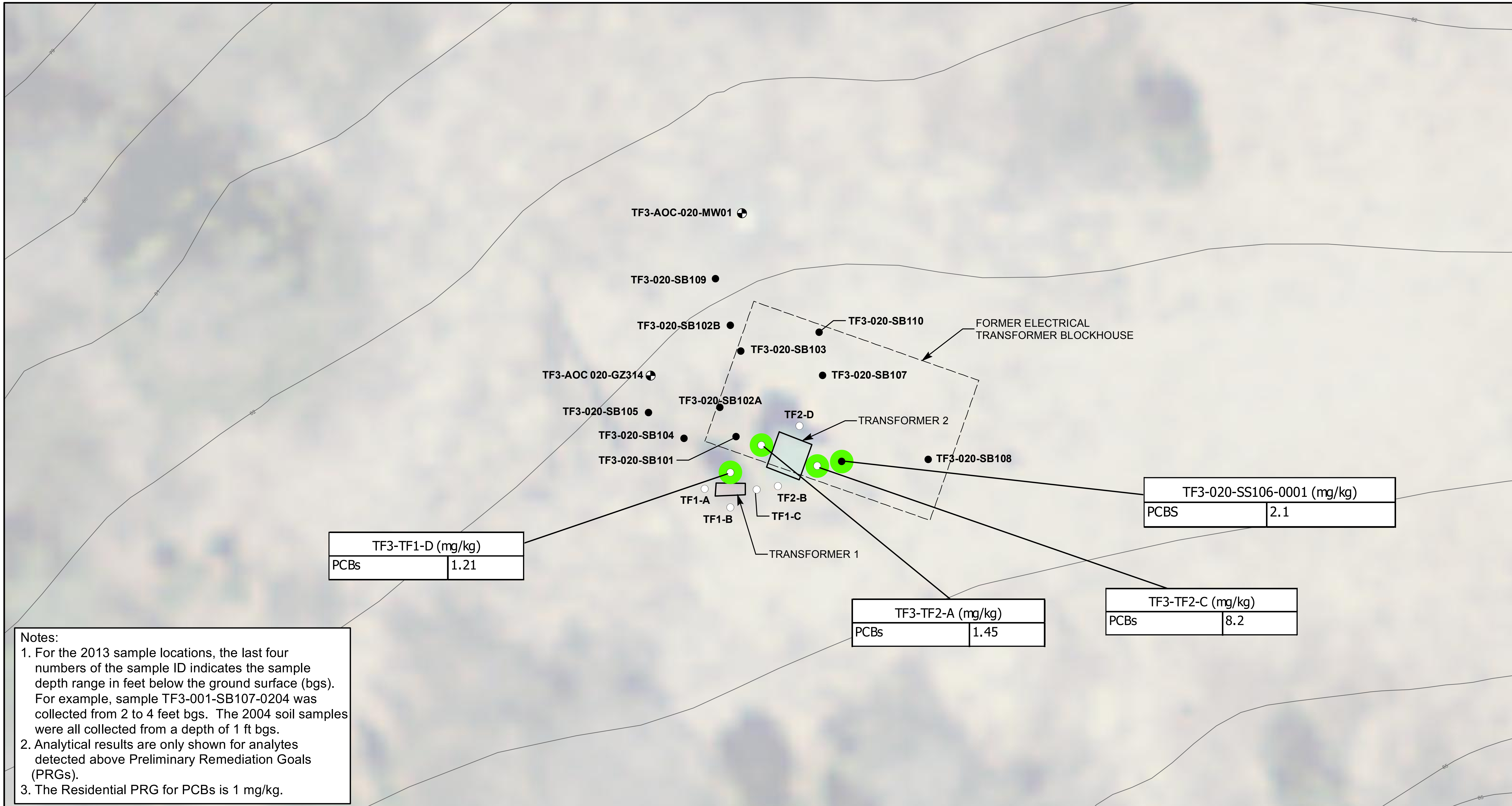
N

0 5 10
Scale in Feet

FIGURE 10
SOILS EXCEEDING PRGS FOR PAHs - DECISION UNIT 3-2

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_10_Site_11_TF3_Soil_Exceed_PRGs_PAH_DU3_2.mxd



Notes:
1. For the 2013 sample locations, the last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs. The 2004 soil samples were all collected from a depth of 1 ft bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. The Residential PRG for PCBs is 1 mg/kg.

RESOLUTION CONSULTANTS

Drawn: JB 10/21/2015
Approved: MK 10/21/2015
Project #: 60266436

Legend
- Monitoring Well Location
- Sample Point Location (2004)
- Soil Boring Location (2013)
- Residential PRG Exceedance
- Existing Structure

N
0 5 10
Scale in Feet

FIGURE 11
SOILS EXCEEDING RESIDENTIAL PRGS FOR PCBS - DECISION UNIT 3-2

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

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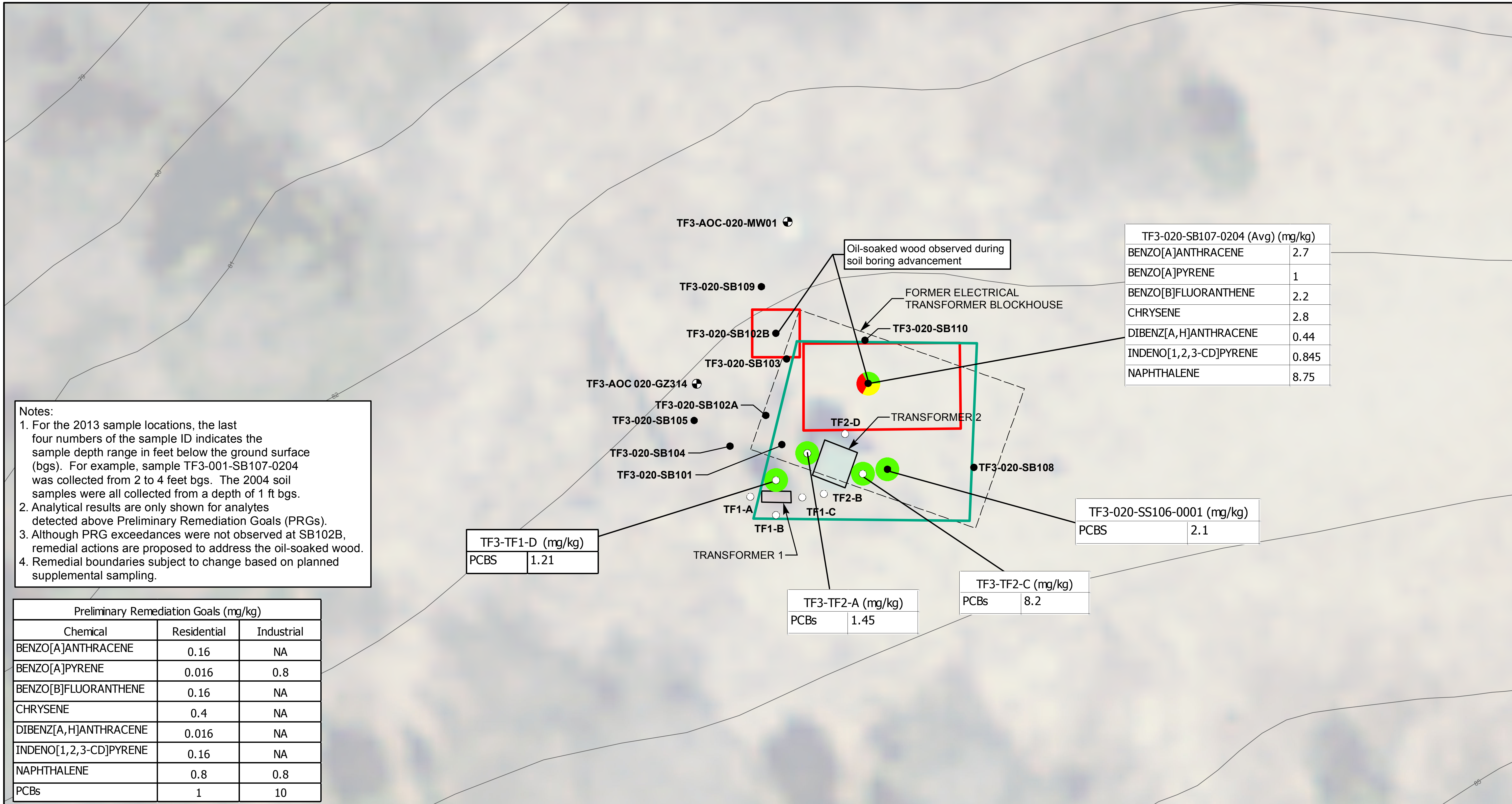

Notes:
1. For the 2013 sample locations, the last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs. The 2004 soil samples were all collected from a depth of 1 ft bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. Although PRG exceedances were not observed at SB102B, remedial actions are proposed to address the oil-soaked wood.
4. Remedial boundaries subject to change based on planned supplemental sampling.

TF3-020-SB107-0204 (Avg) (mg/kg)	
BENZO[A]ANTHRACENE	2.7
BENZO[A]PYRENE	1
BENZO[B]FLUORANTHENE	2.2
CHRYSENE	2.8
DIBENZ[A,H]ANTHRACENE	0.44
INDENO[1,2,3-CD]PYRENE	0.845
NAPHTHALENE	8.75

TF3-020-SS106-0001 (mg/kg)	
PCBS	2.1

TF3-TF1-D (mg/kg)	
PCBS	1.21

TF3-TF2-A (mg/kg)	
PCBs	1.45

TF3-TF2-C (mg/kg)	
PCBs	8.2

Preliminary Remediation Goals (mg/kg)		
Chemical	Residential	Industrial
BENZO[A]ANTHRACENE	0.16	NA
BENZO[A]PYRENE	0.016	0.8
BENZO[B]FLUORANTHENE	0.16	NA
CHRYSENE	0.4	NA
DIBENZ[A,H]ANTHRACENE	0.016	NA
INDENO[1,2,3-CD]PYRENE	0.16	NA
NAPHTHALENE	0.8	0.8
PCBs	1	10

RESOLUTION CONSULTANTS

Drawn: JB 04/04/2016

Approved: MK 04/04/2016

Project #: 60266436

Legend
- Monitoring Well Location
- Sample Point Location (2004)
- Soil Boring Location (2013)
- RIDEM GA Leachability Exceedance
- Industrial PRG Exceedance
- Residential PRG Exceedance
- Estimated Extent of LUCs under Alternatives S-2 and S-3
- Estimated Extent of Excavation under Alternative S-2 and Impermeable Cap under Alternative S-3
- Topographic Contour Line (NAVD 88)
- Existing Structure

N

0 5 10

Scale in Feet

FIGURE 12
SUMMARY OF SOILS EXCEEDING PRGS - DECISION UNIT 3-2

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

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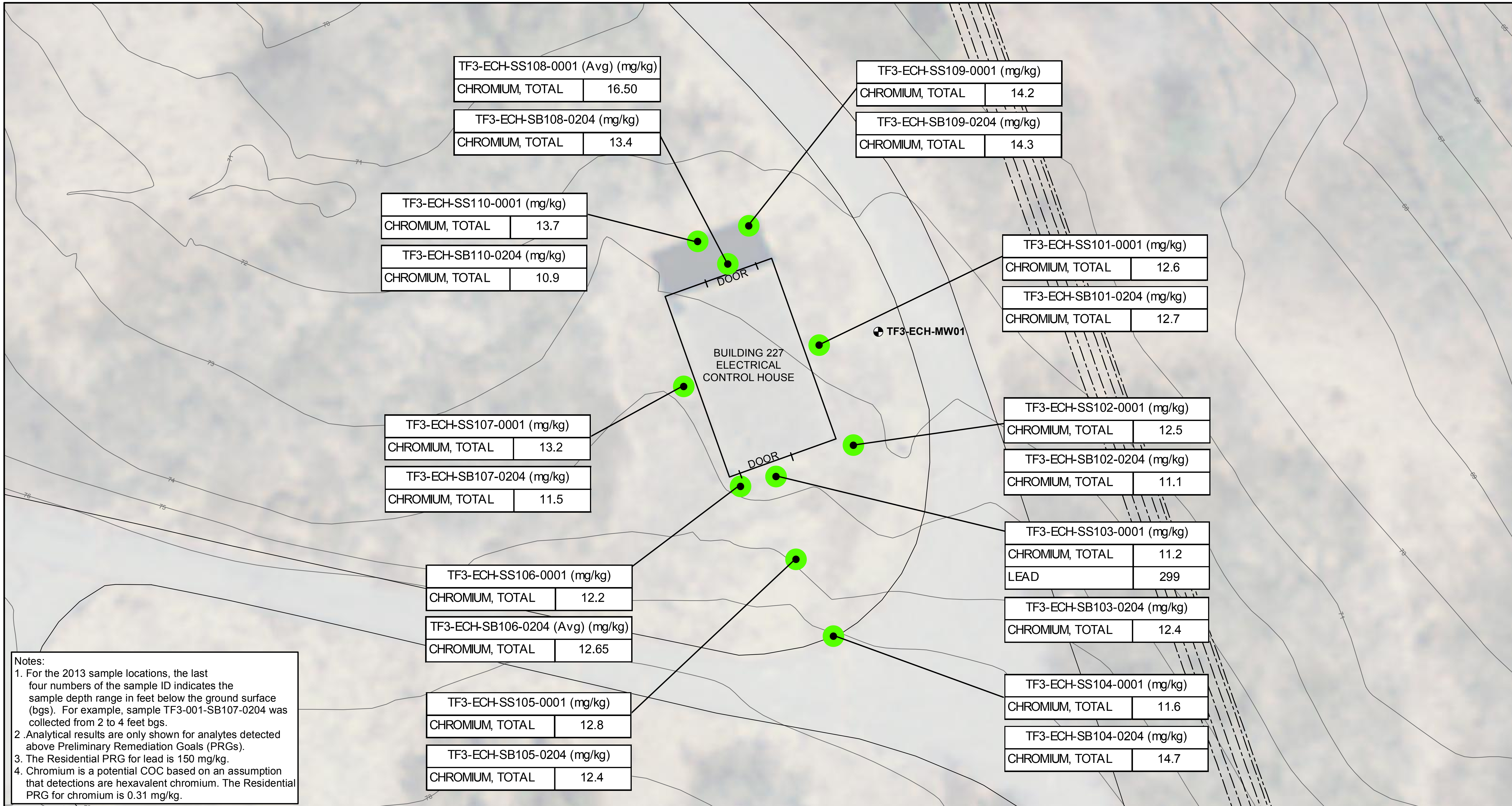


Notes:
1. For the 2013 sample locations, the last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs.
2 .Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. The Residential PRG for lead is 150 mg/kg.
4. Chromium is a potential COC based on an assumption that detections are hexavalent chromium. The Residential PRG for chromium is 0.31 mg/kg.

Legend
- Monitoring Well Location
- Soil Boring Location (2013)
- Residential PRG Exceedance
- Topographic Contour Line (NAVD 88)
- Petroleum Distribution (Remaining)
- Existing Structure

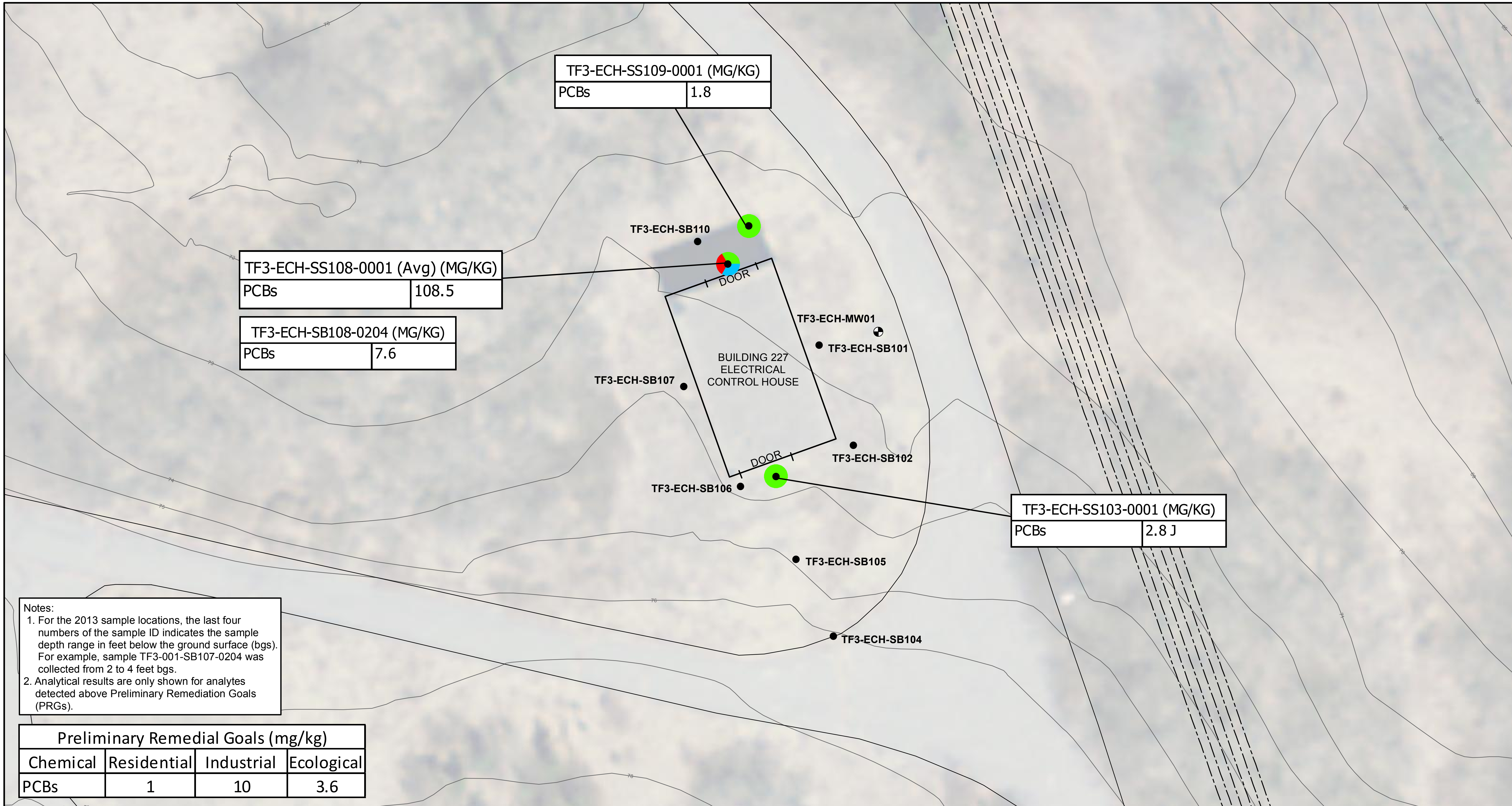
RESOLUTION CONSULTANTS

Drawn: JB 08/09/2016
Approved: MK 08/09/2016
Project #: 60266436

FIGURE 13
SOILS EXCEEDING RESIDENTIAL PRGS FOR METALS - DECISION UNIT 3-3

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

Path: P:\Govt\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\GIS\Projects\Tank_Farm_3\FS\MXD\Fig_13_Site_11_TF3_Soil_Exceed_PRGs_Metals_ECH_Area.mxd



Notes:
1. For the 2013 sample locations, the last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).

Preliminary Remedial Goals (mg/kg)			
Chemical	Residential	Industrial	Ecological
PCBs	1	10	3.6

Legend
- Monitoring Well Location
- Soil Boring Location (2013)
- Ecological PRG Exceedance
- Industrial PRG Exceedance
- Residential PRG Exceedance
- Petroleum Distribution (Remaining)
- Existing Structure

RESOLUTION CONSULTANTS

Drawn: JB 10/21/2015
Approved: MK 10/21/2015
Project #: 60266436

FIGURE 14
SOILS EXCEEDING PRGS FOR PCBS - DECISION UNIT 3-3

SITE 11 - TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

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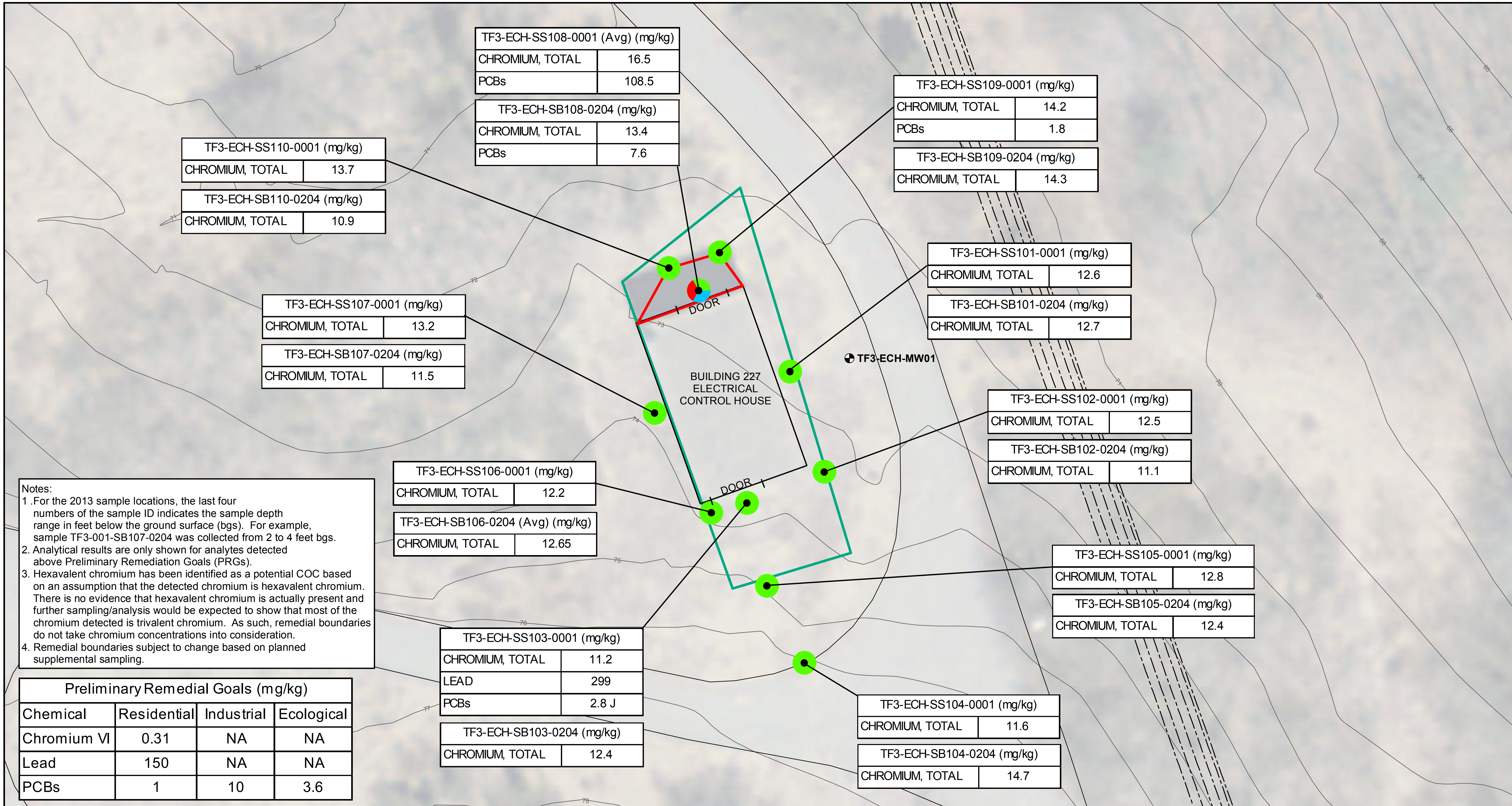

TF3-ECH-SS108-0001 (Avg) (mg/kg)	
CHROMIUM, TOTAL	16.5
PCBs	108.5

TF3-ECH-SB108-0204 (mg/kg)	
CHROMIUM, TOTAL	13.4
PCBs	7.6

TF3-ECH-SS109-0001 (mg/kg)	
CHROMIUM, TOTAL	14.2
PCBs	1.8

TF3-ECH-SB109-0204 (mg/kg)	
CHROMIUM, TOTAL	14.3

TF3-ECH-SS110-0001 (mg/kg)	
CHROMIUM, TOTAL	13.7

TF3-ECH-SB110-0204 (mg/kg)	
CHROMIUM, TOTAL	10.9

TF3-ECH-SS101-0001 (mg/kg)	
CHROMIUM, TOTAL	12.6

TF3-ECH-SB101-0204 (mg/kg)	
CHROMIUM, TOTAL	12.7

TF3-ECH-SS107-0001 (mg/kg)	
CHROMIUM, TOTAL	13.2

TF3-ECH-SB107-0204 (mg/kg)	
CHROMIUM, TOTAL	11.5

TF3-ECH-SS102-0001 (mg/kg)	
CHROMIUM, TOTAL	12.5

TF3-ECH-SB102-0204 (mg/kg)	
CHROMIUM, TOTAL	11.1

TF3-ECH-SS106-0001 (mg/kg)	
CHROMIUM, TOTAL	12.2

TF3-ECH-SB106-0204 (Avg) (mg/kg)	
CHROMIUM, TOTAL	12.65

TF3-ECH-SS105-0001 (mg/kg)	
CHROMIUM, TOTAL	12.8

TF3-ECH-SB105-0204 (mg/kg)	
CHROMIUM, TOTAL	12.4

TF3-ECH-SS103-0001 (mg/kg)	
CHROMIUM, TOTAL	11.2
LEAD	299
PCBs	2.8 J

TF3-ECH-SB103-0204 (mg/kg)	
CHROMIUM, TOTAL	12.4

TF3-ECH-SS104-0001 (mg/kg)	
CHROMIUM, TOTAL	11.6

TF3-ECH-SB104-0204 (mg/kg)	
CHROMIUM, TOTAL	14.7

Notes:
1. For the 2013 sample locations, the last four numbers of the sample ID indicates the sample depth range in feet below the ground surface (bgs). For example, sample TF3-001-SB107-0204 was collected from 2 to 4 feet bgs.
2. Analytical results are only shown for analytes detected above Preliminary Remediation Goals (PRGs).
3. Hexavalent chromium has been identified as a potential COC based on an assumption that the detected chromium is hexavalent chromium. There is no evidence that hexavalent chromium is actually present and further sampling/analysis would be expected to show that most of the chromium detected is trivalent chromium. As such, remedial boundaries do not take chromium concentrations into consideration.
4. Remedial boundaries subject to change based on planned supplemental sampling.

Preliminary Remedial Goals (mg/kg)			
Chemical	Residential	Industrial	Ecological
Chromium VI	0.31	NA	NA
Lead	150	NA	NA
PCBs	1	10	3.6

RESOLUTION CONSULTANTS

Drawn: JB 08/09/2016
Approved: MK 08/09/2016
Project #: 60266436

Legend
- Monitoring Well Location
- Soil Boring Location (2013)
- Ecological PRG Exceedance
- Industrial PRG Exceedance
- Residential PRG Exceedance
- Topographic Contour Line (NAVD 88)
- Petroleum Distribution (Remaining)
- Estimated Extent of LUCs under Alternatives S-2 and S-3
- Estimated Extent of Excavation under Alternative S-2 and Impermeable Cap under Alternative S-3
- Existing Structure

N
0 10 20
Scale in Feet

FIGURE 15
SUMMARY OF SOILS EXCEEDING PRGS- DECISION UNIT 3-3

SITE 11 – TANK FARM 3
NAVSTA NEWPORT, RHODE ISLAND

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Appendix A

Calculation of Preliminary Remediation Goals for Decision Units 3-1, 3-2, and 3-3

APPENDIX A.1 – HUMAN HEALTH PRG DEVELOPMENT

TABLE 1
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURES
TANK FARM 3, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
Surface Soil	Surface Soil (including fugitive dust)	Tank Farm 3	Benzo(a)pyrene	2E-06	4E-12	8E-07	--	3E-06
			2,3,7,8-TCDD Equivalents	3E-05	2E-10	3E-06	--	3E-05
			Aroclor-1260	1E-04	8E-10	5E-05	--	2E-04
			Chromium VI	5E-05	1E-07	- -	--	5E-05
			Chemical Total	2E-04	1.3E-07	6E-05	--	3E-04
		Exposure Point Total						3E-04
	Exposure Medium Total							3E-04
Medium Total								3E-04
All Soil	All Soil (including fugitive dust)	Tank Farm 3	Benzo(a)anthracene	5E-06	1E-11	2E-06	--	7E-06
			Benzo(a)pyrene	2E-05	4E-11	7E-06	--	2E-05
			Benzo(b)fluoranthene	4E-06	8E-12	1E-06	--	5E-06
			Dibenzo(a,h)anthracene	8E-06	2E-11	3E-06	--	1E-05
			Indeno(1,2,3-cd)pyrene	2E-06	3E-12	6E-07	--	2E-06
			Naphthalene	- -	2E-06	- -	--	2E-06
			Aroclor-1260	7E-05	5E-10	3E-05	--	1E-04
			2,3,7,8-TCDD Equivalents	1E-05	7E-11	9E-07	--	1E-05
			Arsenic	7E-06	8E-10	1E-06	--	8E-06
			Chromium VI	5E-05	1E-07	- -	--	5E-05
			Chemical Total	2E-04	2.1E-06	5E-05	--	2E-04
		Exposure Point Total						2E-04
	Exposure Medium Total							2E-04
Medium Total								2E-04

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 2

VALUES USED FOR DAILY INTAKE CALCULATIONS - RESIDENT

REASONABLE MAXIMUM EXPOSURE

TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion/Dermal/ Inhalation	Resident	Young Child/Adult					See DGA Table 5-12	See attached
			THQ	Target Hazard Quotient	1	- -		
			$AT\text{-}N_C$	Averaging Time (Non-Cancer) - child	2,190	days		
			ED_C	Exposure Duration - child	6	years		
			BW_C	Body Weight - child	15	kg		
			EF_C	Exposure Frequency - child	350	days/year		
			ET_C	Exposure Time - child	24	hours/day		
			IR_C	Ingestion Rate of Soil - child	200	mg/day		
			CF	Conversion Factor	0.000001	kg/mg		
			SA_C	Surface Area - child	2,373	cm^2	(a)	
			AF_C	Adherence Factor - child	0.2	mg/cm^2-day		
			ABS	Dermal Absorption Fraction	see Table 7	- -		
			$AT\text{-}N_A$	Averaging Time (Non-Cancer) - adult	7,300	days		
			ED_A	Exposure Duration - adult	20	years		
			BW_A	Body Weight - adult	80	kg		
			EF_A	Exposure Frequency - adult	350	days/year		
			ET_A	Exposure Time -adult	24	hours/day		
			IR_A	Ingestion Rate of Soil - adult	100	mg/day		
			SA_A	Surface Area - adult	6,032	cm^2		
			AF_A	Adherence Factor - adult	0.07	mg/cm^2-day		
			RBA	Relative Bioavailability	0.6 for Arsenic/1 for all other analytes	- -		
			TR	Target ILCR	10^{-6} to 10^{-4}	- -		
			AT-C	Averaging Time (Cancer)	25,550	days		
			PEF	Particulate Emission Factor	1.10E+10	m^3/kg		
			VF	Volatilization Factor	see Table 10	m^3/kg	(b)	
			CF2	Conversion Factor 2	1000	ug/mg		
			RfD_O	Oral Reference Dose	see Table 3	mg/kg-day		
			RfD_D	Dermal Reference Dose	see Table 3	mg/kg-day		
			RfC	Reference Concentration	see Table 4	ug/m^3		
			SF_O	Oral Slope Factor	see Table 5	$(mg/kg\text{-}day)^{-1}$		
			SF_D	Dermal Slope Factor	see Table 5	$(mg/kg\text{-}day)^{-1}$		
			UR	Unit Risk	see Table 6	$(ug/m^3)^{-1}$		
			$ED_{0\text{-}2}$	Exposure Duration - 0-2 yrs	2	years		
			$ED_{2\text{-}6}$	Exposure Duration - 2-6 yrs	4	years		
			$ED_{6\text{-}16}$	Exposure Duration - 6-16 yrs	10	years		
			$ED_{16\text{-}26}$	Exposure Duration - 16-26 yrs+	10	years		

Notes:

(a) - The default value of 2,690 cm^2 was updated by USEPA in February 2015 to 2,373 cm^2. Therefore, the more recent value has been used to derive PRGs for this site.

(b) - The volatilization factor (VF) applies to those COCs considered volatile. The November 2015 update of EPA's Regional Screening Levels (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm) defines benzo(a)anthracene, naphthalene, 2,3,7,8-TCDD, and Aroclor-1260 as volatile and provides chemical-specific VFs which have been applied during the PRG development process.

Intake Equation/
Model Name

Preliminary Remediation Goal (PRG) non-cancer:

Ingestion - child

$$PRG_{nc\text{-}ing}\ (mg/kg) = \frac{THQ \times AT\text{-}N_C \times RfD_o \times BW_C}{EF_C \times ED_C \times IR_C \times CF \times RBA}$$

Dermal - child

$$PRG_{nc\text{-}derm}\ (mg/kg) = \frac{THQ \times AT\text{-}N_C \times RfD_D \times BW_C}{EF_C \times ED_C \times SA_C \times AF_C \times ABS \times CF}$$

Inhalation - child

$$PRG_{nc\text{-}inh}\ (mg/kg) = \frac{THQ \times AT\text{-}N_C \times RfC}{EF_C \times (ET_C/24\ hrs/day) \times (1/PEF + 1/VF) \times ED_C \times CF2}$$

Total - child

$$PRG_{nc\text{-}tot}\ (mg/kg) = \frac{1}{1/PRG_{nc\text{-}ing} + 1/PRG_{nc\text{-}derm} + 1/PRG_{nc\text{-}inh}}$$

Ingestion - adult

$$PRG_{nc\text{-}ing}\ (mg/kg) = \frac{THQ \times AT\text{-}N_A \times RfD_o \times BW_A}{EF_A \times ED_A \times IR_A \times CF \times RBA}$$

Dermal - adult

$$PRG_{nc\text{-}derm}\ (mg/kg) = \frac{THQ \times AT\text{-}N_A \times RfD_D \times BW_A}{EF_A \times ED_A \times SA_A \times AF_A \times ABS \times CF}$$

Inhalation - adult

$$PRG_{nc\text{-}inh}\ (mg/kg) = \frac{THQ \times AT\text{-}N_A \times RfC}{EF_A \times (ET_A/24\ hrs/day) \times (1/PEF + 1/VF) \times ED_A \times CF2}$$

Total - adult

$$PRG_{nc\text{-}tot}\ (mg/kg) = \frac{1}{1/PRG_{nc\text{-}ing} + 1/PRG_{nc\text{-}derm} + 1/PRG_{nc\text{-}inh}}$$

Preliminary Remediation Goal (PRG) cancer:

Ingestion

$$PRG_{ca\text{-}ing}\ (mg/kg) = \frac{TR \times AT\text{-}C}{SF_o \times IFS_{adj} \times CF \times RBA}$$

$$IFS_{adj}\ (mg/kg) = \frac{ED_C \times EF_C \times IR_C}{BW_C} + \frac{ED_A \times EF_A \times IR_A}{BW_A}$$

Dermal

$$PRG_{ca\text{-}derm}\ (mg/kg) = \frac{TR \times AT\text{-}C}{SF_D \times DFS_{adj} \times ABS \times CF}$$

$$DFS_{adj}\ (mg/kg) = \frac{ED_C \times EF_C \times SA_C \times AF_C}{BW_C} + \frac{ED_A \times EF_A \times SA_A \times AF_A}{BW_A}$$

Inhalation

$$PRG_{ca\text{-}inh}\ (mg/kg) = \frac{TR \times AT\text{-}C}{UR \times CF2 \times EF_A \times (ET_A/24\ hrs/day)\ (1/PEF + 1/VF) \times (ED_A + ED_C)}$$

$$INF_{adj} = ED_C \times UR + ED_A \times UR$$

Total

$$PRG_{ca\text{-}tot}\ (mg/kg) = \frac{1}{1/PRG_{ca\text{-}ing} + 1/PRG_{ca\text{-}derm} + 1/PRG_{ca\text{-}inh}}$$

Preliminary Remediation Goal (PRG) mutagenic:

Ingestion

$$PRG_{mu\text{-}ing}\ (mg/kg) = \frac{TR \times AT\text{-}C}{SF_o \times IFSM_{adj} \times CF \times RBA}$$

$$IFSM_{adj}\ (mg/kg) = \frac{ED_{0\text{-}2} \times EF_C \times IR_C \times 10}{BW_C} + \frac{ED_{2\text{-}6} \times EF_C \times IR_C \times 3}{BW_C} + \frac{ED_{6\text{-}16} \times EF_A \times IR_A \times 3}{BW_A} + \frac{ED_{16\text{-}26} \times EF_A \times IR_A}{BW_A}$$

Dermal

$$PRG_{mu\text{-}derm}\ (mg/kg) = \frac{TR \times AT\text{-}C}{SF_D \times DFSM_{adj} \times ABS \times CF}$$

$$DFSM_{adj}\ (mg/kg) = \frac{ED_{0\text{-}2} \times EF_C \times AF_C \times SA_C \times 10}{BW_C} + \frac{ED_{2\text{-}6} \times EF_C \times AF_C \times SA_C \times 3}{BW_C} + \frac{ED_{6\text{-}16} \times EF_A \times AF_A \times SA_A \times 3}{BW_A} + \frac{ED_{16\text{-}26} \times EF_A \times AF_A \times SA_A}{BW_A}$$

Inhalation

$$PRG_{mu\text{-}inh}\ (mg/kg) = \frac{TR \times AT\text{-}C}{CF2 \times EF_A \times (1/PEF + 1/VF) \times INFM_{adj}}$$

$$INFM_{adj} = ED_{0\text{-}2} \times UR \times 10 + ED_{2\text{-}6} \times UR \times 3 + ED_{6\text{-}16} \times UR \times 3 + ED_{16\text{-}30} \times UR$$

Total

$$PRG_{mu\text{-}tot}\ (mg/kg) = \frac{1}{1/PRG_{mu\text{-}ing} + 1/PRG_{mu\text{-}derm} + 1/PRG_{mu\text{-}inh}}$$

Notes

IFS_{adj} - age-adjusted soil ingestion factor

DFS_{adj} - age-adjusted soil dermal factor

$IFSM_{adj}$ - mutagenic age-adjusted soil ingestion factor

$DFSM_{adj}$ - mutagenic age-adjusted soil dermal factor

INF_{adj} - age-adjusted inhalation factor

$INFM_{adj}$ - mutagenic age-adjusted inhalation factor

TABLE 3

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Semivolatile Organic Compounds										
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	4/30/2014
Dioxins/Furans										
2,3,7,8-TCDD Equivalents	Chronic	7.0E-10	mg/kg/day	1	7.0E-10	mg/kg/day	Reproductive	30/1	IRIS	4/30/2014
PCBs										
Aroclor-1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics										
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, Cardiovascular System	3/1	IRIS	4/30/2014
Chromium VI (3)	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	None Reported	300/3	IRIS	4/30/2014

Notes:

1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

3 - Values are for hexavalent chromium.

Definitions:

IRIS = Integrated Risk Information System

NA = Not Available.

TABLE 4

NON-CANCER TOXICITY DATA -- INHALATION

TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Semivolatile Organic Compounds									
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.0E-03	mg/m^3	8.6E-04	(mg/kg/day)	Respiratory System	3000/1	IRIS	4/30/2014
Dioxins/Furans									
2,3,7,8-TCDD Equivalents	Chronic	4.0E-08	mg/m^3	1.1E-08	(mg/kg/day)	Liver, Respiratory, Reproductive	NA	Cal EPA	9/2009
PCBs									
Aroclor-1260	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
Arsenic	Chronic	1.5E-05	mg/m^3	4.3E-06	(mg/kg/day)	Skin, Cardiovascular System	NA	Cal EPA	9/2009
Chromium VI (2)	Chronic	1.0E-04	mg/m^3	2.9E-05	(mg/kg/day)	Respiratory	300/1	IRIS	4/30/2014

Notes:

1 - Extrapolated RfD = RfC *$20m^3$/day / 70 kg

2 - Values are for hexavalent chromium.

Definitions:

Cal EPA = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

IRIS = Integrated Risk Information System

NA = Not Applicable

TABLE 5

CANCER TOXICITY DATA -- ORAL/DERMAL

TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Chemical of Potential Concern		Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal(1)	Absorbed Cancer Slope Factor for Dermal(2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
		Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Semivolatile Organic Compounds									
Benzo(a)anthracene	(3)	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(1)	7/1993
Benzo(a)pyrene	(3)	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	4/30/2014
Benzo(b)fluoranthene	(3)	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(1)	7/1993
Dibenzo(a,h)anthracene	(3)	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(1)	7/1993
Indeno(1,2,3-cd)pyrene	(3)	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(1)	7/1993
Naphthalene		NA	NA	NA	NA	NA	C / Carcinogenic potential cannot be determined	IRIS	4/30/2014
Dioxins/Furans									
2,3,7,8-TCDD Equivalents		1.3E+05	$(mg/kg/day)^{-1}$	1	1.3E+05	$(mg/kg/day)^{-1}$	NA	Cal EPA	9/2009
PCBs									
Aroclor-1260		2.0E+00	$(mg/kg/day)^{-1}$	1	2.0E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(2)	9/1996
Inorganics									
Arsenic		1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A / human carcinogen	IRIS	4/30/2014
Chromium VI	(3,4)	5.0E-01	$(mg/kg/day)^{-1}$	0.025	2.0E+01	$(mg/kg/day)^{-1}$	D / Carcinogenic potential cannot be determined (Oral route)	NJDEP	4/8/2009

Notes:

1 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral absorption efficiency for dermal.

3 - Carcinogenic PAHs and hexavalent chromium are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

4 - Values are for hexavalent chromium.

Cal EPA = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

IRIS = Integrated Risk Information System.

NA = Not Available.

NJDEP = New Jersey Department of Environmental Protection.

USEPA(1) = USEPA Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.

USEPA(2) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

TABLE 6

CANCER TOXICITY DATA -- INHALATION

TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Chemical of Potential Concern		Unit Risk		Inhalation Cancer Slope Factor(1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
		Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Semivolatile Organic Compounds								
Benzo(a)anthracene	(2)	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA(1)	9/2009
Benzo(a)pyrene	(2)	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA(1)	9/2009
Benzo(b)fluoranthene	(2)	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA(1)	9/2009
Dibenzo(a,h)anthracene	(2)	1.2E-03	$(ug/m^3)^{-1}$	4.2E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA(1)	9/2009
Indeno(1,2,3-cd)pyrene	(2)	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA(1)	9/2009
Naphthalene		3.4E-05	$(ug/m^3)^{-1}$	1.2E-01	$(mg/kg/day)^{-1}$	C / Carcinogenic potential cannot be determined	Cal EPA(2)	8/2004
Dioxins/Furans								
2,3,7,8-TCDD Equivalents		3.8E+01	$(ug/m^3)^{-1}$	2.0E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	Cal EPA	9/2009
PCBs								
Aroclor-1260		5.7E-04	$(ug/m^3)^{-1}$	2.0E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	USEPA(1)	9/1996
Inorganics								
Arsenic		4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	4/30/2014
Chromium VI	(2,3)	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	A / Known/likely human carcinogen (Inhalation route)	IRIS	4/30/2014

Notes:

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

2 - Carcinogenic PAHs and hexavalent chromium are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

3 - Values are for hexavalent chromium.

Definitions:

IRIS = Integrated Risk Information System.

NA = Not Available.

Cal EPA(1) = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

Cal EPA(2) = Air Toxic Hot Spots: Adoption of a Unit Risk Value for Naphthalene, August 2004.

USEPA(1) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

Table 7. Dermal Worksheet
Intermediate Variables for Calculating DA(event) For Soil
TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Timeframe	Receptor	Exposure Point	Chemical of Potential Concern	Dermal Absorption Fraction (soil)
All	All	All	**Semivolatile Organic Compounds**	
			Benzo(a)anthracene	0.13
			Benzo(a)pyrene	0.13
			Benzo(b)fluoranthene	0.13
			Dibenzo(a,h)anthracene	0.13
			Indeno(1,2,3-cd)pyrene	0.13
			Naphthalene	0.13
			Dioxins/Furans	
			2,3,7,8-TCDD Equivalents	0.03
			PCBs	
			Aroclor-1260	0.14
			Inorganics	
			Arsenic	0.03
			Chromium VI	0

Notes:
All values from EPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.

TABLE 8. INTERMEDIATE RESIDENT SOIL PRG CALCULATIONS - INGESTION

Chemical	Mutagenic?	THQ	AT-N_C	AT-N_A	RfD_o	BW_C	BW_A	EF_C	EF_A	ED_C	ED_A	IR_C	IR_A	CF	RBA	TR	AT-C	SF_o	IFS_{adj}	$IFSM_{adj}$	PRG_{ca-ing}	$PRG_{nc-ing-child}$	$PRG_{nc-ing-adult}$
			days	days	mg/kg-day	kg	kg	days/yr	days/yr	yrs	yrs	mg/day	mg/day	kg/mg			days	$(mg/kg\text{-}day)^{-1}$	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Semivolatile Organic Compounds																							
Benzo(a)anthracene	Y	1	2190	7300	NA	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	7.3E-01	36750	166833	**2.1E-01**	**NA**	**NA**
Benzo(a)pyrene	Y	1	2190	7300	NA	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	7.3E+00	36750	166833	**2.1E-02**	**NA**	**NA**
Benzo(b)fluoranthene	Y	1	2190	7300	NA	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	7.3E-01	36750	166833	**2.1E-01**	**NA**	**NA**
Dibenzo(a,h)anthracene	Y	1	2190	7300	NA	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	7.3E+00	36750	166833	**2.1E-02**	**NA**	**NA**
Indeno(1,2,3-cd)pyrene	Y	1	2190	7300	NA	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	7.3E-01	36750	166833	**2.1E-01**	**NA**	**NA**
Naphthalene	N	1	2190	7300	2E-02	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	NA	36750	166833	**NA**	**1.6E+03**	**1.7E+04**
Dioxins/Furans																							
2,3,7,8-TCDD Equivalents	N	1	2190	7300	7E-10	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	1.3E+05	36750	166833	**5.3E-06**	**5.5E-05**	**5.8E-04**
PCBs																							
Aroclor-1260	N	1	2190	7300	NA	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	2.0E+00	36750	166833	**3.5E-01**	**NA**	**NA**
Inorganics																							
Arsenic	N	1	2190	7300	3E-04	15	80	350	350	6	20	200	100	1E-06	0.6	1E-06	25550	1.5E+00	36750	166833	**7.7E-01**	**3.9E+01**	**4.2E+02**
Chromium VI	Y	1	2190	7300	3E-03	15	80	350	350	6	20	200	100	1E-06	1	1E-06	25550	5.0E-01	36750	166833	**3.1E-01**	**2.3E+02**	**2.5E+03**

Notes

See Table 2 for input parameters and equations

NA - Not applicable or not available.

Chromium PRGs are based on hexavalent chromium toxicity data.

TABLE 9. INTERMEDIATE RESIDENT SOIL PRG CALCULATIONS - DERMAL

Chemical	Mutagenic?	THQ	$AT\text{-}N_C$ days	$AT\text{-}N_A$ days	RfD_D mg/kg-day	BW_C kg	BW_A kg	EF_C days/yr	EF_A days/yr	ED_C yrs	ED_A yrs	SA_C cm^2	SA_A cm^2	AF_C mg/cm^2-day	AF_A mg/cm^2-day	ABS	CF kg/mg	TR	AT-C days	SF_D $(mg/kg\text{-}day)^{-1}$	DFS_{adj} mg/kg	$DFSM_{adj}$ mg/kg	$PRG_{ca\text{-}derm}$ mg/kg	$PRG_{nc\text{-}derm\text{-}child}$ mg/kg	$PRG_{nc\text{-}derm\text{-}adult}$ mg/kg
Semivolatile Organic Compounds																									
Benzo(a)anthracene	Y	1	2190	7300	NA	15	80	350	350	6	20	2373	6032	0.2	0.07	0.13	0.000001	1E-06	25550	7.3E-01	103390	428260	**6.3E-01**	**NA**	**NA**
Benzo(a)pyrene	Y	1	2190	7300	NA	15	80	350	350	6	20	2373	6032	0.2	0.07	0.13	0.000001	1E-06	25550	7.3E+00	103390	428260	**6.3E-02**	**NA**	**NA**
Benzo(b)fluoranthene	Y	1	2190	7300	NA	15	80	350	350	6	20	2373	6032	0.2	0.07	0.13	0.000001	1E-06	25550	7.3E-01	103390	428260	**6.3E-01**	**NA**	**NA**
Dibenzo(a,h)anthracene	Y	1	2190	7300	NA	15	80	350	350	6	20	2373	6032	0.2	0.07	0.13	0.000001	1E-06	25550	7.3E+00	103390	428260	**6.3E-02**	**NA**	**NA**
Indeno(1,2,3-cd)pyrene	Y	1	2190	7300	NA	15	80	350	350	6	20	2373	6032	0.2	0.07	0.13	0.000001	1E-06	25550	7.3E-01	103390	428260	**6.3E-01**	**NA**	**NA**
Naphthalene	N	1	2190	7300	2E-02	15	80	350	350	6	20	2373	6032	0.2	0.07	0.13	0.000001	1E-06	25550	NA	103390	428260	**NA**	**5.1E+03**	**3.0E+04**
Dioxins/Furans																									
2,3,7,8-TCDD Equivalents	N	1	2190	7300	7E-10	15	80	350	350	6	20	2373	6032	0.2	0.07	0.03	0.000001	1E-06	25550	1.3E+05	103390	428260	**6.3E-05**	**7.7E-04**	**4.6E-03**
PCBs																									
Aroclor-1260	N	1	2190	7300	NA	15	80	350	350	6	20	2373	6032	0.2	0.07	0.14	0.000001	1E-06	25550	2.0E+00	103390	428260	**8.8E-01**	**NA**	**NA**
Inorganics																									
Arsenic	N	1	2190	7300	3E-04	15	80	350	350	6	20	2373	6032	0.2	0.07	0.03	0.000001	1E-06	25550	1.5E+00	103390	428260	**5.5E+00**	**3.3E+02**	**2.0E+03**
Chromium VI	Y	1	2190	7300	8E-05	15	80	350	350	6	20	2373	6032	0.2	0.07	0	0.000001	1E-06	25550	2.0E+01	103390	428260	**NA**	**NA**	**NA**

Notes

See Table 2 for input parameters and equations

NA - Not applicable or not available.

Chromium PRGs are based on hexavalent chromium toxicity data.

TABLE 10. INTERMEDIATE RESIDENT SOIL PRG CALCULATIONS - PARTICULATE INHALATION

Chemical	Mutagenic?	EF_A days/yr	EF_C days/yr	ED_C yrs	ED_A yrs	ET_C hrs/day	ET_A hrs/day	PEF m^3/kg	VF m^3/kg	$AT\text{-}N_C$ days	$AT\text{-}N_A$ days	AT-C days	UR $(ug/m^3)^{-1}$	RfC ug/m^3	CF2 ug/mg	THQ	TR	INF_{adj} $yr\text{-}ug/m^3$	$INFM_{adj}$ $yr\text{-}ug/m^3$	$PRG_{ca\text{-}inh}$ mg/kg	$PRG_{nc\text{-}inh\text{-}child}$ mg/kg	$PRG_{nc\text{-}inh\text{-}adult}$ mg/kg
Semivolatile Organic Compounds																						
Benzo(a)anthracene	Y	350	350	6	20	24	24	1.10E+10	4.41E+06	2190	7300	25550	1.1E-04	NA	1E+03	1	1E-06	2.9E-03	7.9E-03	**4.1E+01**	**NA**	**NA**
Benzo(a)pyrene	Y	350	350	6	20	24	24	1.10E+10	NA	2190	7300	25550	1.1E-03	NA	1E+03	1	1E-06	2.9E-02	7.9E-02	**1.0E+04**	**NA**	**NA**
Benzo(b)fluoranthene	Y	350	350	6	20	24	24	1.10E+10	NA	2190	7300	25550	1.1E-04	NA	1E+03	1	1E-06	2.9E-03	7.9E-03	**1.0E+05**	**NA**	**NA**
Dibenzo(a,h)anthracene	Y	350	350	6	20	24	24	1.10E+10	NA	2190	7300	25550	1.2E-03	NA	1E+03	1	1E-06	3.1E-02	8.6E-02	**9.3E+03**	**NA**	**NA**
Indeno(1,2,3-cd)pyrene	Y	350	350	6	20	24	24	1.10E+10	NA	2190	7300	25550	1.1E-04	NA	1E+03	1	1E-06	2.9E-03	7.9E-03	**1.0E+05**	**NA**	**NA**
Naphthalene	N	350	350	6	20	24	24	1.10E+10	4.6E+04	2190	7300	25550	3.4E-05	3E+00	1E+03	1	1E-06	8.8E-04	2.4E-03	**3.8E+00**	**1.4E+02**	**1.4E+02**
Dioxins/Furans																						
2,3,7,8-TCDD Equivalents	N	350	350	6	20	24	24	1.10E+10	1.96E+06	2190	7300	25550	3.8E+01	4E-05	1E+03	1	1E-06	9.9E+02	2.7E+03	**1.4E-04**	**8.2E-02**	**8.2E-02**
PCBs																						
Aroclor-1260	N	350	350	6	20	24	24	1.10E+10	1.31E+06	2190	7300	25550	5.7E-04	NA	1E+03	1	1E-06	1.5E-02	4.1E-02	**6.5E+00**	**NA**	**NA**
Inorganics																						
Arsenic	N	350	350	6	20	24	24	1.10E+10	NA	2190	7300	25550	4.3E-03	2E-02	1E+03	1	1E-06	1.1E-01	3.1E-01	**7.2E+03**	**1.7E+05**	**1.7E+05**
Chromium VI	Y	350	350	6	20	24	24	1.10E+10	NA	2190	7300	25550	8.4E-02	1E-01	1E+03	1	1E-06	2.2E+00	6.0E+00	**1.3E+02**	**1.1E+06**	**1.1E+06**

Notes

See Table 4 for input parameters and equations

NA - Not applicable or not available.

PRGs shown as "NA" are due to either lack of inhalation toxicity values or because the analyte is non-volatile.

Chromium PRGs are based on hexavalent chromium toxicity data.

VF applied to volatile chemicals: benzo(a)anthracene, naphthalene, 2,3,7,8-TCDD, and Aroclor-1260

TABLE 11. INTERMEDIATE RESIDENT SOIL PRG CALCULATIONS - RESULTS

Chemical	Carcinogenic Risk Level = 1E-06				Non-Cancer HQ = 1 - Child				Non-Cancer HQ = 1 - Adult			
	PRG_{ca-ing} mg/kg	$PRG_{ca-derm}$ mg/kg	PRG_{ca-inh} mg/kg	Result mg/kg	PRG_{nc-ing} mg/kg	$PRG_{nc-derm}$ mg/kg	PRG_{nc-inh} mg/kg	Result mg/kg	PRG_{nc-ing} mg/kg	$PRG_{nc-derm}$ mg/kg	PRG_{nc-inh} mg/kg	Result mg/kg
Semivolatile Organic Compounds												
Benzo(a)anthracene	2.1E-01	6.3E-01	4.1E+01	**1.6E-01**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
Benzo(a)pyrene	2.1E-02	6.3E-02	1.0E+04	**1.6E-02**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
Benzo(b)fluoranthene	2.1E-01	6.3E-01	1.0E+05	**1.6E-01**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
Dibenzo(a,h)anthracene	2.1E-02	6.3E-02	9.3E+03	**1.6E-02**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
Indeno(1,2,3-cd)pyrene	2.1E-01	6.3E-01	1.0E+05	**1.6E-01**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
Naphthalene	NA	NA	3.8E+00	**3.8E+00**	1.6E+03	5.1E+03	1.4E+02	**1.3E+02**	1.7E+04	3.0E+04	1.4E+02	**1.4E+02**
Dioxins/Furans												
2,3,7,8-TCDD Equivalents	5.3E-06	6.3E-05	1.4E-04	**4.8E-06**	5.5E-05	7.7E-04	8.2E-02	**5.1E-05**	5.8E-04	4.6E-03	8.2E-02	**5.2E-04**
PCBs												
Aroclor-1260	3.5E-01	8.8E-01	6.5E+00	**2.4E-01**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
Inorganics												
Arsenic	7.7E-01	5.5E+00	7.2E+03	**6.8E-01**	3.9E+01	3.3E+02	1.7E+05	**3.5E+01**	4.2E+02	2.0E+03	1.7E+05	**3.4E+02**
Chromium VI	3.1E-01	NA	1.3E+02	**3.1E-01**	2.3E+02	NA	1.1E+06	**2.3E+02**	2.5E+03	NA	1.1E+06	**2.5E+03**

Notes
See Table 2 for equations
HQ = Hazard Quotient
The lowest non-cancer PRG between the child and adult is used as the non-cancer PRG.
NA - Not applicable or not available.
Chromium PRGs are based on hexavalent chromium toxicity data.

TABLE 12. HUMAN HEALTH PRELIMINARY REMEDIATION GOALS (PRGs) FOR SOIL
TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

		Regulatory Criteria			Risk-Based PRGs[2]								Selected		Selected		Decision Unit Applicability[8]		
Media/		RIDEM Rem. Regs [1]			ILCR				Site-specific Background Levels[3]			RI	Surface Soil		Subsurface Soil				
Scenario	Contaminant	Leachability	I/C DEC	Res. DEC	10^{-6}	10^{-5}	10^{-4}	HQ = 1	Surface Soil	Subsurface Soil	TSCA[7]	Background[4]	PRG[10]	Basis	PRG[10]	Basis	DU 3-1	DU 3-2	DU 3-3
Site-wide Soil - mg/kg (Hypothetical Residential Scenario)																			
	Benzo(a)anthracene	- -	NA	0.9	0.16	1.6	16	NA	- -	- -	- -	- -	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
	Benzo(a)pyrene	240	NA	0.4	0.016	0.16	1.6	NA	- -	- -	- -	- -	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	X	X	
	Benzo(b)fluoranthene	- -	NA	0.9	0.16	1.6	16	NA	- -	- -	- -	- -	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
	Chrysene[5]	- -	NA	0.4	NA	NA	NA	NA	- -	- -	- -	- -	0.4	Res. DEC	0.4	Res. DEC		X	
	Dibenzo(a,h)anthracene	- -	NA	0.4	0.016	0.16	1.6	NA	- -	- -	- -	- -	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	X	X	
	Indeno(1,2,3-cd)pyrene	- -	NA	0.9	0.16	1.6	16	NA	- -	- -	- -	- -	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	X	X	
	Naphthalene	0.8	NA	54	3.8	38	380	128	- -	- -	- -	- -	0.8	Leachabilty	0.8	Leachabilty	X	X	
	2,3,7,8-TCDD Equivalents	- -	NA	- -	0.0000048	0.000048	0.00048	0.000051	- -	- -	- -	- -	0.0000048	ILCR = 10^{-6}	0.0000048	ILCR = 10^{-6}	X		
	PCBs	10	NA	10	0.24	2.4	24	NA	- -	- -	1	- -	1	TSCA	1	TSCA		X	X
	Arsenic[6]	- -	NA	7	0.68	6.8	68	35	17	6	- -	7	17	Background	7	Res DEC	X		X
	Chromium VI[9]	- -	NA	390	0.31	3.1	31	235	--	--	- -	--	0.31	ILCR = 10^{-6}	0.31	ILCR = 10^{-6}	X		X
	Lead[5]	- -	NA	150	NA	NA	NA	NA	31	7.9	- -	13.91	150	Res. DEC	150	Res. DEC			X
	Manganese[5]	- -	NA	390	NA	NA	NA	NA	260	460	- -	- -	390	Res. DEC	460	Background	X		X
Site-wide Soil - mg/kg (Industrial Worker/Restricted Recreational Scenario)																			
	Benzo(a)pyrene[5]	240	0.8	NA	NA	NA	NA	NA	- -	- -	- -	- -	0.8	I/C DEC	0.8	I/C DEC		X	
	Naphthalene[5]	0.8	10000	NA	NA	NA	NA	NA	- -	- -	- -	- -	0.8	Leachabilty	0.8	Leachabilty		X	
	PCBs[5]	10	10	NA	NA	NA	NA	NA	- -	- -	- -	- -	10	I/C DEC	10	I/C DEC			X
	Arsenic[5,6]	- -	7	NA	NA	NA	NA	NA	17	6	- -	7	17	Background	7	I/C DEC	X		

Notes

ILCR - Incremental Lifetime Cancer Risk
HQ - Hazard Quotient
NA - Not carcinogenic, or a carcinogen was not evaluated for potential non-carcinogenic effects; not applicable
AOC - Area of Concern
ECH - Electrical Control House

1. RIDEM Rem. Regs. - RIDEM Remediation Regulations, DEM-DSR-01-93, February 2004, Table 1 (Residential Direct Exposure Criteria [DEC] and Industrial/Commercial [I/C] DEC) and Table 2 (GA Leachability Criteria); - - = no criterion
2. Risk-based PRGs are developed based on risk results from the human health risk assessment and consider the ingestion, dermal and inhalation routes of exposure, as applicable. Noncancer PRGs are based on child exposure, while cancer PRGs are based on lifetime exposure. The only PRGs included were for those analytes which were concluded to be primary risk drivers; if the cancer or non-cancer effects were not shown to be primary risk drivers, a PRG was not presented (NA).
3. Site-specific background values generated in Appendix A.3
   - - = not detected
4. Arsenic background based on RIDEM Rem. Regs, February 2004. Other background values - statewide geometric mean provided in Background Levels of Priority Pollutant Metals in Rhode Island Soils, Rhode Island Department of Environmental Management Division of Site Remedation.
5. Analyte included only due to detections in exceedance of RIDEM Regulatory Criteria. As this analyte was not determined to be a risk driver in the Baseline Human Health Risk Assessment, risk-based PRG calculations are not included for this analyte/exposure scenario. Comparison of maximum detected concentrations to regulatory criteria presented in Tables 14, 15, and 16 of this attachment.
6. While the RIDEM DEC is set at Rhode Island background (7 mg/kg), additional guidance specific to arsenic remediation is provided in the RIDEM Remediation Regulations, DEM-DSR-01-93, February 2004, Section 12.0. Higher concentrations of arsenic are allowable, depending on other site conditions/actions.
7. TSCA - Toxic Substances Control Act; Section 761.61(c) of TSCA (see Appendix B for full citation) allows for risk-based cleanup of PCB remediation waste. EPA guidance on Remedial Actions for Superfund Sites with PCB Contamination (OSWER Directive #9355.4-01FS; EPA/540/G-90/007; August 1990) was utilized to develop the risk-based value presented. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.
8. Decision Unit Applicability - While the risk assessment evaluated all three DUs together, the various analytes were analyzed/detected in specific DUs based on the conceptual site model. The PRGs are applicable to those specific DUs.

Notes Continued:

9. Chromium speciation has not been performed for this site. At this time, chromium has been assumed to be hexavalent chromium even though there is no current evidence that it would be this species. Further sampling/analysis is anticipated to show that most of the chromium detected is trivalent chromium. Upon confirmation of this assumption, chromium would no longer be a chemical of concern (COC) at this site.
10. For the contaminants listed above, selected PRGs were identified as the lower of the risk-based goals or ARAR (if available). If site-specific background values are available and applicable, the greater of the two values was selected as the PRG.

TABLE 13. HUMAN HEALTH PRELIMINARY REMEDIATION GOALS (PRGs) FOR SOIL - RESIDUAL RISK
TANK FARM 3 CATEGORY 1 AREAS, NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND

Media/ Scenario	Contaminant	Regulatory Criteria: RIDEM Rem. Regs [1]: Leachability	I/C DEC	Res. DEC	Risk-Based PRGs [2]: ILCR: 10^{-6}	10^{-5}	10^{-4}	HQ = 1	Additional Information: Site-specific Background Levels [3]: Surface Soil	Subsurface Soil	TSCA [7]	RI Background [4]	Selected Surface Soil PRG	Basis	Selected Subsurface Soil PRG	Basis	Residual Risk At PRG: Surface Soil: Estimated ILCR	Surface Soil: Estimated HQ	Subsurface Soil: Estimated ILCR	Subsurface Soil: Estimated HQ
Site-wide Soil - mg/kg (Hypothetical Residential Scenario)																				
	Benzo(a)anthracene	- -	NA	0.9	0.16	1.6	16	NA	- -	- -	- -	- -	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	1E-06	N/A	1E-06	N/A
	Benzo(a)pyrene	240	NA	0.4	0.016	0.16	1.6	NA	- -	- -	- -	- -	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	1E-06	N/A	1E-06	N/A
	Benzo(b)fluoranthene	- -	NA	0.9	0.16	1.6	16	NA	- -	- -	- -	- -	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	1E-06	N/A	1E-06	N/A
	Chrysene[5]	- -	NA	0.4	NA	NA	NA	NA	- -	- -	- -	- -	0.4	Res. DEC	0.4	Res. DEC	N/A	N/A	N/A	N/A
	Dibenzo(a,h)anthracene	- -	NA	0.4	0.016	0.16	1.6	NA	- -	- -	- -	- -	0.016	ILCR = 10^{-6}	0.016	ILCR = 10^{-6}	1E-06	N/A	1E-06	N/A
	Indeno(1,2,3-cd)pyrene	- -	NA	0.9	0.16	1.6	16	NA	- -	- -	- -	- -	0.16	ILCR = 10^{-6}	0.16	ILCR = 10^{-6}	1E-06	N/A	1E-06	N/A
	Naphthalene	0.8	NA	54	3.8	38	380	128	- -	- -	- -	- -	0.8	Leachability	0.8	Leachabilty	2E-07	5E-03	2E-07	5E-03
	2,3,7,8-TCDD Equivalents	- -	NA	- -	0.0000048	0.000048	0.00048	0.000051	- -	- -	- -	- -	0.0000048	ILCR = 10^{-6}	0.0000048	ILCR = 10^{-6}	9E-07	9E-02	9E-07	9E-02
	PCBs	10	NA	10	0.24	2.4	24	NA	- -	- -	1	- -	1	TSCA	1	TSCA	4E-06	N/A	4E-06	N/A
	Arsenic[6]	- -	NA	7	0.68	6.8	68	35	17	6	- -	7	17	Background	7	Res DEC	3E-05	5E-01	1E-05	2E-01
	Chromium VI[8]	- -	NA	390	0.31	3.1	31	235	--	--	- -	- -	0.31	ILCR = 10^{-6}	0.31	ILCR = 10^{-6}	1E-06	1E-03	1E-06	1E-03
	Lead[5]	- -	NA	150	NA	NA	NA	NA	31	7.9	- -	13.91	150	Res. DEC	150	Res. DEC				
	Manganese[5]	- -	NA	390	NA	NA	NA	NA	260	460	- -	- -	390	Res. DEC	460	Background	N/A	2E-01	N/A	2E-01
																	4E-05		**2E-05**	
Site-wide Soil - mg/kg (Industrial Worker/Restricted Recreational Scenario)																				
	Benzo(a)pyrene[5]	240	0.8	NA	NA	NA	NA	NA	- -	- -	- -	- -	0.8	I/C DEC	0.8	I/C DEC	3E-06	N/A	3E-06	N/A
	Naphthalene[5]	0.8	10000	NA	NA	NA	NA	NA	- -	- -	- -	- -	0.8	Leachabilty	0.8	Leachabilty	4E-08	1E-03	4E-08	1E-03
	PCBs[5]	10	10	NA	NA	NA	NA	NA	- -	- -	- -	- -	10	I/C DEC	10	I/C DEC	1E-05	N/A	1E-05	N/A
	Arsenic[5,6]	- -	7	NA	NA	NA	NA	NA	17	6	- -	7	17	Background	7	I/C DEC	6E-06	3E-02	2E-06	1E-02
																	2E-05		**1E-05**	

Notes

ILCR - Incremental Lifetime Cancer Risk

HQ - Hazard Quotient

NA - Not carcinogenic, or a carcinogen was not evaluated for potential non-carcinogenic effects; not applicable

AOC - Area of Concern

ECH - Electrical Control House

1. RIDEM Rem. Regs. - RIDEM Remediation Regulations, DEM-DSR-01-93, February 2004, Table 1 (Residential Direct Exposure Criteria [DEC] and Industrial/Commercial [I/C] DEC) and Table 2 (GA Leachability Criteria); - - = no criterion
2. Risk-based PRGs are developed based on risk results from the human health risk assessment and consider the ingestion, dermal and inhalation routes of exposure, as applicable. Noncancer PRGs are based on child exposure, while cancer PRGs are based on lifetime exposure. The only PRGs included were for those analytes which were concluded to be primary risk drivers; if the cancer or non-cancer effects were not shown to be primary risk drivers, a PRG was not presented (NA).
3. Site-specific background values generated in Appendix A.3
   - - = not detected
4. Arsenic background based on RIDEM Rem. Regs, February 2004. Other background values - statewide geometric mean provided in Background Levels of Priority Pollutant Metals in Rhode Island Soils, Rhode Island Department of Environmental Management Division of Site Remedation.
5. Analyte included only due to detections in exceedance of RIDEM Regulatory Criteria. As this analyte was not determined to be a risk driver in the Baseline Human Health Risk Assessment, risk-based PRG calculations are not included for this analyte/exposure scenario. Comparison of maximum detected concentrations to regulatory criteria presented in Tables 14, 15, and 16 of this attachment.
6. While the RIDEM DEC is set at Rhode Island background (7 mg/kg), additional guidance specific to arsenic remediation is provided in the RIDEM Remediation Regulations, DEM-DSR-01-93, February 2004, Section 12.0. Higher concentrations of arsenic are allowable, depending on other site conditions/actions.
7. TSCA - Toxic Substances Control Act; Section 761.61(c) of TSCA (see Appendix B for full citation) allows for risk-based cleanup of PCB remediation waste. EPA guidance on Remedial Actions for Superfund Sites with PCB Contamination (OSWER Directive #9355.4-01FS; EPA/540/G-90/007; August 1990) was utilized to develop the risk-based value presented. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.
8. Chromium speciation has not been performed for this site. At this time, chromium has been assumed to be hexavalent chromium even though there is no current evidence that it would be this species. Further sampling/analysis is anticipated to show that mo: chromium detected is trivalent chromium. Upon confirmation of this assumption, chromium would no longer be a chemical of concern (COC) at this site.

TABLE 14. COMPARISON OF MAXIMUM DETECTED CONCENTRATIONS TO ARARS - DU 3-1

Analyte	Maximum Detected Conc. (mg/kg)	RIDEM Method 1 Soil Objective (Residential)	RIDEM Method 1 Soil Objective (Industrial/ Commercial)	RIDEM Method 1 Soil Objective (GA Leachability Criteria)
2-BUTANONE	3.00E-02	1.00E+04	1.00E+04	NA
4-ISOPROPYLTOLUENE	9.70E-04	2.70E+01	1.00E+04	NA
ACENAPHTHENE	6.80E-02	4.30E+01	1.00E+04	NA
ACENAPHTHYLENE	1.80E-03	2.30E+01	1.00E+04	NA
ACETONE	1.40E-01	7.80E+03	1.00E+04	NA
ALUMINUM	1.55E+04	NA	NA	NA
ANTHRACENE	1.10E-02	3.50E+01	1.00E+04	NA
ANTIMONY	1.40E-01	1.00E+01	8.20E+02	NA
ARSENIC	9.80E+00	7.00E+00	7.00E+00	NA
BARIUM	3.63E+01	5.50E+03	1.00E+04	NA
BENZO[A]ANTHRACENE	6.90E-02	9.00E-01	7.80E+00	NA
BENZO[A]PYRENE	7.40E-02	4.00E-01	8.00E-01	2.40E+02
BENZO[B]FLUORANTHENE	1.10E-01	9.00E-01	7.80E+00	NA
BENZO[G,H,I]PERYLENE	2.80E-02	8.00E-01	1.00E+04	NA
BENZO[K]FLUORANTHENE	4.40E-02	9.00E-01	7.80E+01	NA
BERYLLIUM	4.40E-01	1.50E+00	1.50E+00	NA
CADMIUM	1.20E-01	3.90E+01	1.00E+03	NA
CALCIUM	5.06E+03	EN	EN	EN
CARBON DISULFIDE	4.70E-02	NA	NA	NA
CHROMIUM, TOTAL	2.39E+01	3.90E+02	1.00E+04	NA
CHRYSENE	8.20E-02	4.00E-01	7.80E+02	NA
COBALT	2.09E+01	NA	NA	NA
COPPER	2.28E+01	3.10E+03	1.00E+04	NA
DIBENZ[A,H]ANTHRACENE	1.20E-02	4.00E-01	8.00E-01	NA
ETHYLBENZENE	6.60E-04	7.10E+01	1.00E+04	2.70E+01
FLUORANTHENE	1.10E-01	2.00E+01	1.00E+04	NA
FLUORENE	1.90E-01	2.80E+01	1.00E+04	NA
INDENO[1,2,3-CD]PYRENE	5.80E-02	9.00E-01	7.80E+00	NA
IRON	3.62E+04	NA	NA	NA
ISOPROPYLBENZENE	5.20E-03	2.70E+01	1.00E+04	NA
LEAD	2.14E+01	1.50E+02	5.00E+02	NA
M- AND P-XYLENE	3.70E-03	NA	NA	NA
MAGNESIUM	5.33E+03	EN	EN	EN
MANGANESE	5.95E+02	3.90E+02	1.00E+04	NA
MERCURY	4.00E-02	2.30E+01	6.10E+02	NA
METHYL ACETATE	6.00E-02	NA	NA	NA
N-BUTYLBENZENE	6.20E-02	NA	NA	NA
NICKEL	3.57E+01	1.00E+03	1.00E+04	NA
O-XYLENE	1.60E-03	NA	NA	NA
PHENANTHRENE	3.50E-01	4.00E+01	1.00E+04	NA
POTASSIUM	1.05E+03	EN	EN	EN
PYRENE	1.50E-01	1.30E+01	1.00E+04	NA
SEC-BUTYLBENZENE	5.70E-02	NA	NA	NA
SELENIUM	5.20E-01	3.90E+02	1.00E+04	NA
SILVER	7.00E-02	2.00E+02	1.00E+04	NA
SODIUM	7.68E+01	EN	EN	EN
DIOXIN TEQ (ng/kg)	1.50E+02	NA	NA	NA
THALLIUM	9.00E-02	5.50E+00	1.40E+02	NA
TOLUENE	1.40E-03	1.90E+02	1.00E+04	3.20E+01

TPH-GASOLINE RANGE C6-C12	6.20E+01	5.00E+02	2.50E+03	NA
VANADIUM	2.70E+01	5.50E+02	1.00E+04	NA
XYLENES, TOTAL	5.20E-03	1.10E+02	1.00E+04	5.40E+02
ZINC	9.44E+01	6.00E+03	1.00E+04	NA

Notes
NA = not applicable/not available
EN = essential nutrient
Highlighted cells show the criteria exceeded by the maximum detected concentration.

TABLE 15. COMPARISON OF MAXIMUM DETECTED CONCENTRATIONS TO ARARS - DU 3-2

Analyte	Maximum Detected Conc. (mg/kg)	RIDEM Method 1 Soil Objective (Residential)	RIDEM Method 1 Soil Objective (Industrial/ Commercial)	RIDEM Method 1 Soil Objective (GA Leachability Criteria)
2-BUTANONE	8.70E-03	1.00E+04	1.00E+04	NA
2-METHYLNAPHTHALENE	1.80E+00	1.23E+02	1.00E+04	NA
ACENAPHTHENE	3.20E+00	4.30E+01	1.00E+04	NA
ACENAPHTHYLENE	1.20E-01	2.30E+01	1.00E+04	NA
ANTHRACENE	4.10E+00	3.50E+01	1.00E+04	NA
AROCLOR-1242	2.80E-01	1.00E+01	1.00E+01	1.00E+01
AROCLOR-1254	1.20E+00	1.00E+01	1.00E+01	1.00E+01
AROCLOR-1260	8.20E+00	1.00E+01	1.00E+01	1.00E+01
BENZO[A]ANTHRACENE	2.70E+00	9.00E-01	7.80E+00	NA
BENZO[A]PYRENE	1.00E+00	4.00E-01	8.00E-01	2.40E+02
BENZO[B]FLUORANTHENE	2.20E+00	9.00E-01	7.80E+00	NA
BENZO[G,H,I]PERYLENE	2.20E-01	8.00E-01	1.00E+04	NA
BENZO[K]FLUORANTHENE	8.40E-01	9.00E-01	7.80E+01	NA
CHRYSENE	2.80E+00	4.00E-01	7.80E+02	NA
DIBENZ[A,H]ANTHRACENE	4.40E-01	4.00E-01	8.00E-01	NA
FLUORANTHENE	6.30E+00	2.00E+01	1.00E+04	NA
FLUORENE	3.00E+00	2.80E+01	1.00E+04	NA
INDENO[1,2,3-CD]PYRENE	8.50E-01	9.00E-01	7.80E+00	NA
NAPHTHALENE	8.80E+00	5.40E+01	1.00E+04	8.00E-01
PHENANTHRENE	1.00E+01	4.00E+01	1.00E+04	NA
POLYCHLORINATED BIPHENYLS (PCBS)	8.20E+00	1.00E+01	1.00E+01	1.00E+01
PYRENE	5.70E+00	1.30E+01	1.00E+04	NA

Notes
NA = not applicable/not available
EN = essential nutrient
Highlighted cells show the criteria exceeded by the maximum detected concentration.

TABLE 16. COMPARISON OF MAXIMUM DETECTED CONCENTRATIONS TO ARARS - DU 3-3

Analyte	Maximum Detected Conc. (mg/kg)	RIDEM Method 1 Soil Objective (Residential)	Method 1 Soil Objective (Industrial/ Commercial)	Method 1 Soil Objective (GA Leachability Criteria)
ALUMINUM	1.41E+04	NA	NA	NA
ANTIMONY	3.30E-01	1.00E+01	8.20E+02	NA
AROCLOR-1260	1.10E+02	1.00E+01	1.00E+01	1.00E+01
ARSENIC	6.30E+00	7.00E+00	7.00E+00	NA
BARIUM	2.90E+01	5.50E+03	1.00E+04	NA
BERYLLIUM	5.20E-01	1.50E+00	1.50E+00	NA
CADMIUM	3.40E-01	3.90E+01	1.00E+03	NA
CALCIUM	3.70E+03	EN	EN	EN
CHROMIUM, TOTAL	1.65E+01	3.90E+02	1.00E+04	NA
COBALT	1.05E+01	NA	NA	NA
COPPER	5.82E+01	3.10E+03	1.00E+04	NA
IRON	2.32E+04	NA	NA	NA
LEAD	2.99E+02	1.50E+02	5.00E+02	NA
MAGNESIUM	3.54E+03	EN	EN	EN
MANGANESE	3.36E+02	3.90E+02	1.00E+04	NA
MERCURY	1.00E-01	2.30E+01	6.10E+02	NA
NICKEL	1.54E+01	1.00E+03	1.00E+04	NA
POLYCHLORINATED BIPHENYLS (PCBS)	1.10E+02	1.00E+01	1.00E+01	1.00E+01
POTASSIUM	8.75E+02	EN	EN	EN
SELENIUM	5.30E-01	3.90E+02	1.00E+04	NA
SILVER	9.00E-02	2.00E+02	1.00E+04	NA
SODIUM	5.55E+01	EN	EN	EN
THALLIUM	1.30E-01	5.50E+00	1.40E+02	NA
VANADIUM	2.65E+01	5.50E+02	1.00E+04	NA
ZINC	6.88E+01	6.00E+03	1.00E+04	NA

Notes

NA = not applicable/not available

EN = essential nutrient

Highlighted cells show the criteria exceeded by the maximum detected concentration.

APPENDIX A.2 – ECOLOGICAL PRG DEVELOPMENT

APPENDIX A.2 TABLE 1

DERIVATION OF PRGs FOR SHORT-TAILED SHREW AT DECISION UNIT 3-3
USING AVERAGE ASSUMPTIONS FROM DGA

$$\text{Total Daily Dose (TDD)} = \frac{\Sigma([IR_f \times C_f] + [IR_s \times C_s] \times ED \times AUF}{\text{Body Weight}}$$

Where:
IR_f = Ingestion rate of food (kg/day)
IR_s = Incidental ingestion rate of soil (kg/day)
C_f = Concentration of COC in food (mg/kg)
C_s= Concentration of COC in soil (mg/kg)
ED = Exposure duration (fraction of time receptor spends within exposure area)
AUF = Area use factor (ratio of the receptor's home range, etc,... relative to the size of exposure area)

ASSUMPTIONS FOR THE SHORT-TAILED SHREW (per DGA Table I.3)	
Average Body Weight (kg)	0.0161
Exposure Duration (ED)	1.0
Area Use Factor (AUF)	0.10
Average Soil Consumption Rate (kg_{dw}/day)	0.00001289
Average Soil Invt.Consumption Rate (kg_{dw}/day)	0.001433

Notes:
BAF - Bioaccumulation Factor per DGA Table I.5.
COC - Chemical of Concern.
dw - Dry Weight.
HQ - Hazard Quotient (TDD/TRV).
LOAEL - Lowest Observed Adverse Effects Level.
NOAEL - No Observed Adverse Effects Level.
PRG - Preliminary Remediation Goal. Soil concentration that results in a TDD equal to the TRV (i.e., HQ = 1).
TRV - Toxicity Reference Value.

Shrew AUF assumed to be 0.1 (10% of the home range of 0.97 acres).

NOAEL TRV = 0.068 mg/kg_{bw}/day per DGA Table I.1.
LOAEL TRV = 0.68 mg/kg_{bw}/day per DGA Table I.1.

SUPPORTING CALCULATIONS

COC	Media Concentrations			Potential Total Daily Dose (mg/kg_{bw}/day)			Geometric Mean of LOAEL- and NOAEL-based TRVs	HQ
	Soil PRG (mg/kg_{dw})	Soil BAF	Soil Invertebrate (mg/kg_{dw})	Soil	Soil Invertebrate	Total	(mg/kg_{bw}/day)	
POLYCHLORINATED BIPHENYLS - CALCULATION OF PRELIMINARY REMEDIAL GOALS								
Aroclor-1260	3.6	6.67	24.0	0.000288	0.213	0.214	0.215	1

APPENDIX A.2 TABLE 2

DERIVATION OF PRGs FOR AMERICAN ROBIN AT DECISION UNIT 3-3
USING AVERAGE ASSUMPTIONS FROM DGA

ASSUMPTIONS FOR THE AMERICAN ROBIN (per DGA Table I.3)	
Average Body Weight (kg)	0.0804
Exposure Duration	1.0
Area Use Factor	0.10
Average Soil Consumption Rate (kg_{dw}/day)	0.0007601
Average Soil Invt.Consumption Rate (kg_{dw}/day)	0.0119

$$\text{Total Daily Dose (TDD)} = \frac{\Sigma([IR_f \times C_f] + [IR_s \times C_s] \times ED \times AUF}{\text{Average Body Weight}}$$

Where:
IR_f = Ingestion rate of food (kg/day)
IR_s = Incidental ingestion rate of soil (kg/day)
C_f = Concentration of COC in food (mg/kg)
C_s= Concentration of COC in soil (mg/kg)
ED = Exposure duration (fraction of time receptor spends within exposure area)
AUF = Area use factor (ratio of the receptor's home range, etc,... relative to the size of exposure area)

Notes:
BAF - Bioaccumulation Factor per DGA Table I.5.
COC - Chemical of Concern.
dw - Dry Weight.
HQ - Hazard Quotient (TDD/TRV).
LOAEL - Lowest Observed Adverse Effects Level.
NOAEL - No Observed Adverse Effects Level.
PRG - Preliminary Remediation Goal. Soil concentration that results in a TDD equal to the TRV (i.e., HQ = 1).
TRV - Toxicity Reference Value.

Robin AUF assumed to be 0.1 (10% of the home range of 0.61 acres).

NOAEL TRV = 0.18 mg/kg_{bw}/day per DGA Table I.1.
LOAEL TRV = 1.8 mg/kg_{bw}/day per DGA Table I.1.

SUPPORTING CALCULATIONS

COC	Media Concentrations			Potential Total Daily Dose (mg/kg_{bw}/day)			Geometric Mean of LOAEL- and NOAEL-based TRVs	HQ
	Soil PRG (mg/kg_{dw})	Soil BAF	Soil Invertebrate (mg/kg_{dw})	Soil	Soil Invertebrate	Total	(mg/kg_{bw}/day)	
POLYCHLORINATED BIPHENYLS - CALCULATION OF PRELIMINARY REMEDIAL GOALS								
Aroclor-1260	5.7	6.67	38.0	0.0054	0.56	0.57	0.57	1

APPENDIX A.2 TABLE 3

SUMMARY OF ECOLOGICAL PRGs FOR DECISION UNIT 3-3

Analyte	Basis	Geometric Mean of Receptor PRGs (mg/kg)	Selected Ecological PRG (mg/kg)	Basis
Aroclor-1260	Short-tailed shrew	3.6	3.6	Geometric mean of NOAEL- and LOAEL-based PRGs for the shrew
	American robin	5.7		

Notes:

Ecological PRGs were derived using average food web assumptions from Data Gaps Assessment (DGA; Tetra Tech, 2015).

PRGs assume shrew and robin obtain 10% of their diet from Decision Unit 3-3.

LOAEL - Lowest Observed Adverse Effects Level.

NOAEL - No Observed Adverse Effects Level.

PRG - Preliminary Remediation Goal.

APPENDIX A.3 – BACKGROUND CALCULATIONS

Analytical Results
NS Newport
As Pb Mn BACKGROUND SURFACE

	Site	SITE 00002	SITE 00002	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND
	Location	BKG-SS03-NEB	BKG-SS09-NEB	BWBK-NE01	BWBK-NE02	BWBK-NE03	BWBK-NE04	BWBK-NE05
	Depth	0 - 1.6 ft	0 - 1.8 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft
	Date	1/1/1900 00:00	1/1/1900 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00
	Matrix	SO	SO	SO	SO	SO	SO	SO
	Type	N	N	N	N	N	N	N
	Sample	BKG-SS03-NEB-0016	BKG-SS09-NEB-0018	BWBK-SS-NE01-0001	BWBK-SS-NE02-0001	BWBK-SS-NE03-0001	BWBK-SS-NE04-0001	BWBK-SS-NE05-0001
Analyte	**Units**							
Metals								
ARSENIC	mg/kg	**6.2 J**	**10.8 J**	**14.5**	**17.1**	**8.6**	**6.7**	**9.4**
LEAD	mg/kg	**44 J**	**15.2 J**	**19.7**	**16.5**	**12.3**	**11.6**	**17.4**
MANGANESE	mg/kg	**204**	**179**	**290**	**222**	**192**	**253**	**208**

Analytical Results
NS Newport
As Pb Mn BACKGROUND SURFACE

	Site	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND
	Location	BWBK-NE06	BWBK-NE07	BWBK-NE08	BWBK-NE09	BWBK-NE10	BWBK-NE101	BWBK-NE102
	Depth	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft
	Date	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	3/27/2007 00:00	3/27/2007 00:00
	Matrix	SO	SO	SO	SO	SO	SO	SO
	Type	N	N	N	N	N	N	N
	Sample	BWBK-SS-NE06-0001	BWBK-SS-NE07-0001	BWBK-SS-NE08-0001	BWBK-SS-NE09-0001	BWBK-SS-NE10-0001	BWBK-SS-NE101-0001	BWBK-SS-NE102-0001
Analyte	**Units**							
Metals								
ARSENIC	mg/kg	**5.6**	**11.7**	**6.4**	**8.3**	**8.2**	**3.1**	**2.4**
LEAD	mg/kg	**9.8**	**24.2**	**11.3**	**17.4**	**26.3**	**8.2**	**12.7**
MANGANESE	mg/kg	**184**	**177**	**185**	**219**	**193**	**146**	**128**

Analytical Results
NS Newport
As Pb Mn BACKGROUND SURFACE

	Site	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND
	Location	BWBK-NE103	BWBK-NE104	BWBK-NE105	BWBK-NE106	BWBK-NE107	BWBK-NE108	BWBK-NE109
	Depth	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft	0 - 1 ft
	Date	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00
	Matrix	SO	SO	SO	SO	SO	SO	SO
	Type	N	N	N	N	N	N	N
	Sample	BWBK-SS-NE103-0001	BWBK-SS-NE104-0001	BWBK-SS-NE105-0001	BWBK-SS-NE106-0001	BWBK-SS-NE107-0001	BWBK-SS-NE108-0001	BWBK-SS-NE109-0001
Analyte	**Units**							
Metals								
ARSENIC	mg/kg	**2.8**	**2.4**	**2.2**	**2.3**	**2.3**	**2.4**	**1.7**
LEAD	mg/kg	**11.6**	**21.9**	**8.5**	**24.4**	**12.2**	**13.8**	**8.4**
MANGANESE	mg/kg	**104**	**133**	**119**	**130**	**164**	**129**	**119**

Analytical Results
NS Newport
As Pb Mn BACKGROUND SURFACE

	Site	BACKGROUND
	Location	BWBK-NE110
	Depth	0 - 1 ft
	Date	3/27/2007 00:00
	Matrix	SO
	Type	N
	Sample	BWBK-SS-NE110-0001
Analyte	**Units**	
Metals		
ARSENIC	mg/kg	**3**
LEAD	mg/kg	**17.8**
MANGANESE	mg/kg	**85.5**

Analytical Results
NS Newport
As Pb Mn BACKGROUND SUBSURFACE

	Site	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND
	Location	BWBK-NE01	BWBK-NE02	BWBK-NE03	BWBK-NE04	BWBK-NE05	BWBK-NE06	BWBK-NE07
	Depth	1 - 8 ft	1 - 9 ft	1 - 5 ft	1 - 10 ft	1 - 8 ft	1 - 9 ft	1 - 7 ft
	Date	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00
	Matrix	SO	SO	SO	SO	SO	SO	SO
	Type	N	N	N	N	N	N	N
	Sample	BWBK-SB-NE01-0108	BWBK-SB-NE02-0109	BWBK-SB-NE03-0105	BWBK-SB-NE04-0110	BWBK-SB-NE05-0108	BWBK-SB-NE06-0109	BWBK-SB-NE07-0107
Analyte	**Units**							
Metals	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**
ARSENIC	mg/kg	**5.2**	**5.8**	**5.5**	**4.6**	**5**	**4.9**	**5.2**
LEAD	mg/kg	**7.4**	**7.5**	**6.9**	**7.3**	**6.9 J**	**7**	**7.8**
MANGANESE	mg/kg	**359**	**634**	**301**	**344**	**325**	**319**	**300**

Analytical Results
NS Newport
As Pb Mn BACKGROUND SUBSURFACE

	Site	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND
	Location	BWBK-NE08	BWBK-NE09	BWBK-NE10	BWBK-NE101	BWBK-NE102	BWBK-NE103	BWBK-NE104
	Depth	1 - 4 ft	1 - 10 ft	1 - 7 ft	1 - 10 ft	1 - 10 ft	1 - 10 ft	1 - 10 ft
	Date	9/13/2006 00:00	9/13/2006 00:00	9/13/2006 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00
	Matrix	SO	SO	SO	SO	SO	SO	SO
	Type	N	N	N	N	N	N	N
	Sample	BWBK-SB-NE08-0104	BWBK-SB-NE09-0110	BWBK-SB-NE10-0107	BWBK-SB-NE101-0110	BWBK-SB-NE102-0110	BWBK-SB-NE103-0110	BWBK-SB-NE104-0110
Analyte	**Units**							
Metals	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**
ARSENIC	mg/kg	**4.4**	**4.3**	**3.8**	**3.2**	**2.6**	**2.4**	**2.1**
LEAD	mg/kg	**6.5**	**6.4**	**7.5**	**7.4 J**	**6.6 J**	**5.6 J**	**5.5**
MANGANESE	mg/kg	**255**	**306**	**249**	**243**	**229**	**209**	**176**

	Site	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND	BACKGROUND
	Location	BWBK-NE105	BWBK-NE106	BWBK-NE107	BWBK-NE108	BWBK-NE109	BWBK-NE110
	Depth	1 - 10 ft	1 - 10 ft	5 - 10 ft	1 - 10 ft	1 - 10 ft	1 - 10 ft
	Date	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00	3/27/2007 00:00
	Matrix	SO	SO	SO	SO	SO	SO
	Type	N	N	N	N	N	N
	Sample	BWBK-SB-NE105-0110	BWBK-SB-NE106-0110	BWBK-SB-NE107-0510	BWBK-SB-NE108-0110	BWBK-SB-NE109-0110	BWBK-SB-NE110-0110
Analyte	**Units**						
Metals	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**	**Metals**
ARSENIC	mg/kg	**3.7**	**2.6**	**1.9**	**2.2**	**2.2**	**2.6**
LEAD	mg/kg	**7.1 J**	**6.5 J**	**5.7 J**	**6.2 J**	**6.4 J**	**6.9**
MANGANESE	mg/kg	**322**	**247**	**200**	**207**	**214**	**244**

	A	B	C	D	E	F	G	H	I	J	K	L
1				Background Statistics for Uncensored Full Data Sets								
2		User Selected Options										
3		Date/Time of Computation		4/2/2016 4:55:09 PM								
4		From File		Y:\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\CTO WE16 - TF FS, EECAs\TF3 FS\DF FS Report\Apper								
5		Full Precision		OFF								
6		Confidence Coefficient		95%								
7		Coverage		95%								
8		New or Future K Observations		1								
9		Number of Bootstrap Operations		2000								
10												
11	ARSENIC_SURFACE_SOIL											
12												
13	General Statistics											
14					Total Number of Observations	22					Number of Distinct Observations	19
15					Minimum	1.7					First Quartile	2.4
16					Second Largest	14.5					Median	5.9
17					Maximum	17.1					Third Quartile	8.525
18					Mean	6.277					SD	4.394
19					Coefficient of Variation	0.7					Skewness	0.963
20					Mean of logged Data	1.597					SD of logged Data	0.719
21												
22				Critical Values for Background Threshold Values (BTVs)								
23					Tolerance Factor K (For UTL)	2.349					d2max (for USL)	2.603
24												
25						Normal GOF Test						
26					Shapiro Wilk Test Statistic	0.873			Shapiro Wilk GOF Test			
27					5% Shapiro Wilk Critical Value	0.911			Data Not Normal at 5% Significance Level			
28					Lilliefors Test Statistic	0.22			Lilliefors GOF Test			
29					5% Lilliefors Critical Value	0.189			Data Not Normal at 5% Significance Level			
30					Data Not Normal at 5% Significance Level							
31												
32					Background Statistics Assuming Normal Distribution							
33				95% UTL with	95% Coverage	16.6					90% Percentile (z)	11.91
34					95% UPL (t)	14.01					95% Percentile (z)	13.5
35					95% USL	17.71					99% Percentile (z)	16.5
36												
37						Gamma GOF Test						
38					A-D Test Statistic	0.849			Anderson-Darling Gamma GOF Test			
39					5% A-D Critical Value	0.755			Data Not Gamma Distributed at 5% Significance Level			
40					K-S Test Statistic	0.216			Kolmogrov-Smirnoff Gamma GOF Test			
41					5% K-S Critical Value	0.188			Data Not Gamma Distributed at 5% Significance Level			
42					Data Not Gamma Distributed at 5% Significance Level							
43												
44						Gamma Statistics						
45					k hat (MLE)	2.239					k star (bias corrected MLE)	1.964
46					Theta hat (MLE)	2.803					Theta star (bias corrected MLE)	3.196
47					nu hat (MLE)	98.54					nu star (bias corrected)	86.43
48					MLE Mean (bias corrected)	6.277					MLE Sd (bias corrected)	4.479
49												
50					Background Statistics Assuming Gamma Distribution							
51					95% Wilson Hilferty (WH) Approx. Gamma UPL	15.47					90% Percentile	12.26
52					95% Hawkins Wixley (HW) Approx. Gamma UPL	15.84					95% Percentile	14.97

95% WH Approx. Gamma UTL with 95% Coverage	20.57	99% Percentile	21
95% HW Approx. Gamma UTL with 95% Coverage	21.62		
95% WH USL	23.08	95% HW USL	24.54

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.196	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.189	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	26.72	90% Percentile (z)	12.41
95% UPL (t)	17.49	95% Percentile (z)	16.11
95% USL	32.06	99% Percentile (z)	26.29

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	22	95% UTL with 95% Coverage	17.1
Approximate f	1.158	Confidence Coefficient (CC) achieved by UTL	0.676
95% Percentile Bootstrap UTL with 95% Coverage	17.1	95% BCA Bootstrap UTL with 95% Coverage	17.1
95% UPL	16.71	90% Percentile	11.61
90% Chebyshev UPL	19.76	95% Percentile	14.36
95% Chebyshev UPL	25.86	99% Percentile	16.55
95% USL	17.1		

Note: The use of USL to estimate a BTV is recommended only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

LEAD_SURFACE _SOIL

General Statistics

Total Number of Observations	22	Number of Distinct Observations	20
Minimum	8.2	First Quartile	11.6
Second Largest	26.3	Median	14.5
Maximum	44	Third Quartile	19.23
Mean	16.6	SD	8.149
Coefficient of Variation	0.491	Skewness	1.93
Mean of logged Data	2.717	SD of logged Data	0.424

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.349	d2max (for USL)	2.603

Normal GOF Test

Shapiro Wilk Test Statistic	0.825	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.169	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Data appear Normal at 5% Significance Level	

	A–E	F	G–K	L
105	**Data appear Approximate Normal at 5% Significance Level**			
106				
107	**Background Statistics Assuming Normal Distribution**			
108	95% UTL with 95% Coverage	35.74	90% Percentile (z)	27.04
109	95% UPL (t)	30.94	95% Percentile (z)	30
110	95% USL	37.81	99% Percentile (z)	35.56
111				
112	**Gamma GOF Test**			
113	A-D Test Statistic	0.424	**Anderson-Darling Gamma GOF Test**	
114	5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
115	K-S Test Statistic	0.132	**Kolmogrov-Smirnoff Gamma GOF Test**	
116	5% K-S Critical Value	0.186	Detected data appear Gamma Distributed at 5% Significance Level	
117	**Detected data appear Gamma Distributed at 5% Significance Level**			
118				
119	**Gamma Statistics**			
120	k hat (MLE)	5.582	k star (bias corrected MLE)	4.851
121	Theta hat (MLE)	2.974	Theta star (bias corrected MLE)	3.422
122	nu hat (MLE)	245.6	nu star (bias corrected)	213.4
123	MLE Mean (bias corrected)	16.6	MLE Sd (bias corrected)	7.537
124				
125	**Background Statistics Assuming Gamma Distribution**			
126	95% Wilson Hilferty (WH) Approx. Gamma UPL	31.12	90% Percentile	26.69
127	95% Hawkins Wixley (HW) Approx. Gamma UPL	31.26	95% Percentile	30.62
128	95% WH Approx. Gamma UTL with 95% Coverage	38.02	99% Percentile	38.93
129	95% HW Approx. Gamma UTL with 95% Coverage	38.59		
130	95% WH USL	41.28	95% HW USL	42.11
131				
132	**Lognormal GOF Test**			
133	Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk Lognormal GOF Test**	
134	5% Shapiro Wilk Critical Value	0.911	Data appear Lognormal at 5% Significance Level	
135	Lilliefors Test Statistic	0.115	**Lilliefors Lognormal GOF Test**	
136	5% Lilliefors Critical Value	0.189	Data appear Lognormal at 5% Significance Level	
137	**Data appear Lognormal at 5% Significance Level**			
138				
139	**Background Statistics assuming Lognormal Distribution**			
140	95% UTL with 95% Coverage	40.96	90% Percentile (z)	26.06
141	95% UPL (t)	31.9	95% Percentile (z)	30.39
142	95% USL	45.61	99% Percentile (z)	40.57
143				
144	**Nonparametric Distribution Free Background Statistics**			
145	**Data appear Approximate Normal at 5% Significance Level**			
146				
147	**Nonparametric Upper Limits for Background Threshold Values**			
148	Order of Statistic, r	22	95% UTL with 95% Coverage	44
149	Approximate f	1.158	Confidence Coefficient (CC) achieved by UTL	0.676
150	95% Percentile Bootstrap UTL with 95% Coverage	44	95% BCA Bootstrap UTL with 95% Coverage	44
151	95% UPL	41.35	90% Percentile	24.38
152	90% Chebyshev UPL	41.6	95% Percentile	26.21
153	95% Chebyshev UPL	52.92	99% Percentile	40.28
154	95% USL	44		
155				
156	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background			

data set free of outliers and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

MANGANESE_SURFACE_SOIL

General Statistics

Total Number of Observations	22	Number of Distinct Observations	21
Minimum	85.5	First Quartile	129.3
Second Largest	253	Median	178
Maximum	290	Third Quartile	201.3
Mean	171.1	SD	50.83
Coefficient of Variation	0.297	Skewness	0.431
Mean of logged Data	5.099	SD of logged Data	0.305

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.349	d2max (for USL)	2.603

Normal GOF Test

Shapiro Wilk Test Statistic	0.968	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.911	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.189	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	290.5	90% Percentile (z)	236.2
95% UPL (t)	260.5	95% Percentile (z)	254.7
95% USL	303.4	99% Percentile (z)	289.3

Gamma GOF Test

A-D Test Statistic	0.298	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.185	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.73	k star (bias corrected MLE)	10.16
Theta hat (MLE)	14.59	Theta star (bias corrected MLE)	16.84
nu hat (MLE)	516	nu star (bias corrected)	447
MLE Mean (bias corrected)	171.1	MLE Sd (bias corrected)	53.67

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	271.1	90% Percentile	242.4
95% Hawkins Wixley (HW) Approx. Gamma UPL	273	95% Percentile	267.8
95% WH Approx. Gamma UTL with 95% Coverage	314.2	99% Percentile	320
95% HW Approx. Gamma UTL with 95% Coverage	318.6		
95% WH USL	334.1	95% HW USL	339.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**

	A	B	C	D	E	F	G	H	I	J	K	L
209	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level					
210	Lilliefors Test Statistic					0.146	**Lilliefors Lognormal GOF Test**					
211	5% Lilliefors Critical Value					0.189	Data appear Lognormal at 5% Significance Level					
212	**Data appear Lognormal at 5% Significance Level**											
213												
214	**Background Statistics assuming Lognormal Distribution**											
215	95% UTL with 95% Coverage					335.3	90% Percentile (z)					242.2
216	95% UPL (t)					280.2	95% Percentile (z)					270.5
217	95% USL					362.3	99% Percentile (z)					333
218												
219	**Nonparametric Distribution Free Background Statistics**											
220	**Data appear Normal at 5% Significance Level**											
221												
222	**Nonparametric Upper Limits for Background Threshold Values**											
223	Order of Statistic, r					22	95% UTL with 95% Coverage					290
224	Approximate f					1.158	Confidence Coefficient (CC) achieved by UTL					0.676
225	95% Percentile Bootstrap UTL with 95% Coverage					290	95% BCA Bootstrap UTL with 95% Coverage					290
226	95% UPL					284.5	90% Percentile					221.7
227	90% Chebyshev UPL					327	95% Percentile					251.5
228	95% Chebyshev UPL					397.6	99% Percentile					282.2
229	95% USL					290						
230												
231	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background											
232	data set free of outliers and consists of observations collected from clean unimpacted locations.											
233	The use of USL tends to provide a balance between false positives and false negatives provided the data											
234	represents a background data set and when many onsite observations need to be compared with the BTV.											
235												

Background Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	4/2/2016 4:57:18 PM		
From File	Y:\Projects\NavyCLEAN AECOM-EnSafe JV\Newport\CTO WE16 - TF FS, EECAs\TF3 FS\DF FS Report\Apper		
Full Precision	OFF		
Confidence Coefficient	95%		
Coverage	95%		
New or Future K Observations	1		
Number of Bootstrap Operations	2000		
ARSENIC_SUBSURFACE_SOIL			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	16
Minimum	1.9	First Quartile	2.55
Second Largest	5.5	Median	3.75
Maximum	5.8	Third Quartile	4.925
Mean	3.71	SD	1.314
Coefficient of Variation	0.354	Skewness	0.0793
Mean of logged Data	1.247	SD of logged Data	0.375
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.396	d2max (for USL)	2.557
Normal GOF Test			
Shapiro Wilk Test Statistic	0.907	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.201	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Background Statistics Assuming Normal Distribution			
95% UTL with 95% Coverage	6.859	90% Percentile (z)	5.394
95% UPL (t)	6.039	95% Percentile (z)	5.872
95% USL	7.07	99% Percentile (z)	6.767
Gamma GOF Test			
A-D Test Statistic	0.775	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.743	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.936	k star (bias corrected MLE)	6.779
Theta hat (MLE)	0.468	Theta star (bias corrected MLE)	0.547
nu hat (MLE)	317.4	nu star (bias corrected)	271.1
MLE Mean (bias corrected)	3.71	MLE Sd (bias corrected)	1.425
Background Statistics Assuming Gamma Distribution			
95% Wilson Hilferty (WH) Approx. Gamma UPL	6.434	90% Percentile	5.613
95% Hawkins Wixley (HW) Approx. Gamma UPL	6.504	95% Percentile	6.322

95% WH Approx. Gamma UTL with 95% Coverage	7.732	99% Percentile	7.799
95% HW Approx. Gamma UTL with 95% Coverage	7.899		
95% WH USL	8.092	95% HW USL	8.292
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.181	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Background Statistics assuming Lognormal Distribution			
95% UTL with 95% Coverage	8.545	90% Percentile (z)	5.626
95% UPL (t)	6.761	95% Percentile (z)	6.447
95% USL	9.075	99% Percentile (z)	8.325
Nonparametric Distribution Free Background Statistics			
Data appear Approximate Normal at 5% Significance Level			
Nonparametric Upper Limits for Background Threshold Values			
Order of Statistic, r	20	95% UTL with 95% Coverage	5.8
Approximate f	1.053	Confidence Coefficient (CC) achieved by UTL	0.642
95% Percentile Bootstrap UTL with 95% Coverage	5.8	95% BCA Bootstrap UTL with 95% Coverage	5.8
95% UPL	5.785	90% Percentile	5.23
90% Chebyshev UPL	7.75	95% Percentile	5.515
95% Chebyshev UPL	9.58	99% Percentile	5.743
95% USL	5.8		
Note: The use of USL to estimate a BTV is recommended only when the data set represents a background			
data set free of outliers and consists of observations collected from clean unimpacted locations.			
The use of USL tends to provide a balance between false positives and false negatives provided the data			
represents a background data set and when many onsite observations need to be compared with the BTV.			
LEAD_SUBSURFACE_SOIL			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	14
Minimum	5.5	First Quartile	6.4
Second Largest	7.5	Median	6.9
Maximum	7.8	Third Quartile	7.325
Mean	6.755	SD	0.661
Coefficient of Variation	0.0979	Skewness	-0.456
Mean of logged Data	1.906	SD of logged Data	0.101
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.396	d2max (for USL)	2.557
Normal GOF Test			
Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level	

	A–E	F	G–K	L
105	**Data appear Normal at 5% Significance Level**			
106				
107	**Background Statistics Assuming Normal Distribution**			
108	95% UTL with 95% Coverage	8.34	90% Percentile (z)	7.603
109	95% UPL (t)	7.927	95% Percentile (z)	7.843
110	95% USL	8.446	99% Percentile (z)	8.293
111				
112	**Gamma GOF Test**			
113	A-D Test Statistic	0.439	**Anderson-Darling Gamma GOF Test**	
114	5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level	
115	K-S Test Statistic	0.149	**Kolmogrov-Smirnoff Gamma GOF Test**	
116	5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level	
117	**Detected data appear Gamma Distributed at 5% Significance Level**			
118				
119	**Gamma Statistics**			
120	k hat (MLE)	106	k star (bias corrected MLE)	90.1
121	Theta hat (MLE)	0.0638	Theta star (bias corrected MLE)	0.075
122	nu hat (MLE)	4238	nu star (bias corrected)	3604
123	MLE Mean (bias corrected)	6.755	MLE Sd (bias corrected)	0.712
124				
125	**Background Statistics Assuming Gamma Distribution**			
126	95% Wilson Hilferty (WH) Approx. Gamma UPL	7.996	90% Percentile	7.682
127	95% Hawkins Wixley (HW) Approx. Gamma UPL	8.006	95% Percentile	7.967
128	95% WH Approx. Gamma UTL with 95% Coverage	8.475	99% Percentile	8.52
129	95% HW Approx. Gamma UTL with 95% Coverage	8.495		
130	95% WH USL	8.602	95% HW USL	8.625
131				
132	**Lognormal GOF Test**			
133	Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk Lognormal GOF Test**	
134	5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
135	Lilliefors Test Statistic	0.152	**Lilliefors Lognormal GOF Test**	
136	5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
137	**Data appear Lognormal at 5% Significance Level**			
138				
139	**Background Statistics assuming Lognormal Distribution**			
140	95% UTL with 95% Coverage	8.559	90% Percentile (z)	7.65
141	95% UPL (t)	8.037	95% Percentile (z)	7.935
142	95% USL	8.698	99% Percentile (z)	8.499
143				
144	**Nonparametric Distribution Free Background Statistics**			
145	**Data appear Normal at 5% Significance Level**			
146				
147	**Nonparametric Upper Limits for Background Threshold Values**			
148	Order of Statistic, r	20	95% UTL with 95% Coverage	7.8
149	Approximate f	1.053	Confidence Coefficient (CC) achieved by UTL	0.642
150	95% Percentile Bootstrap UTL with 95% Coverage	7.8	95% BCA Bootstrap UTL with 95% Coverage	7.8
151	95% UPL	7.785	90% Percentile	7.5
152	90% Chebyshev UPL	8.788	95% Percentile	7.515
153	95% Chebyshev UPL	9.709	99% Percentile	7.743
154	95% USL	7.8		
155				
156	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background			

data set free of outliers and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

MANGANESE_SUBSURFACE_SOIL

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
Minimum	176	First Quartile	225.3
Second Largest	359	Median	252
Maximum	634	Third Quartile	319.8
Mean	284.2	SD	97.88
Coefficient of Variation	0.344	Skewness	2.503
Mean of logged Data	5.607	SD of logged Data	0.284

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.396	d2max (for USL)	2.557

Normal GOF Test

Shapiro Wilk Test Statistic	0.753	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.188	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	518.7	90% Percentile (z)	409.6
95% UPL (t)	457.6	95% Percentile (z)	445.1
95% USL	534.4	99% Percentile (z)	511.8

Gamma GOF Test

A-D Test Statistic	0.712	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.87	k star (bias corrected MLE)	10.12
Theta hat (MLE)	23.93	Theta star (bias corrected MLE)	28.06
nu hat (MLE)	474.9	nu star (bias corrected)	405
MLE Mean (bias corrected)	284.2	MLE Sd (bias corrected)	89.3

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	450.2	90% Percentile	402.9
95% Hawkins Wixley (HW) Approx. Gamma UPL	449.9	95% Percentile	445.2
95% WH Approx. Gamma UTL with 95% Coverage	525.7	99% Percentile	531.9
95% HW Approx. Gamma UTL with 95% Coverage	527.9		
95% WH USL	546.4	95% HW USL	549.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk Lognormal GOF Test**

	A–E	F	G–K	L
209	5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
210	Lilliefors Test Statistic	0.141	**Lilliefors Lognormal GOF Test**	
211	5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
212	**Data appear Lognormal at 5% Significance Level**			
213				
214	**Background Statistics assuming Lognormal Distribution**			
215	95% UTL with 95% Coverage	537.2	90% Percentile (z)	391.6
216	95% UPL (t)	450	95% Percentile (z)	434.1
217	95% USL	562.2	99% Percentile (z)	526.7
218				
219	**Nonparametric Distribution Free Background Statistics**			
220	**Data appear Approximate Normal at 5% Significance Level**			
221				
222	**Nonparametric Upper Limits for Background Threshold Values**			
223	Order of Statistic, r	20	95% UTL with 95% Coverage	634
224	Approximate f	1.053	Confidence Coefficient (CC) achieved by UTL	0.642
225	95% Percentile Bootstrap UTL with 95% Coverage	634	95% BCA Bootstrap UTL with 95% Coverage	634
226	95% UPL	620.3	90% Percentile	345.5
227	90% Chebyshev UPL	585	95% Percentile	372.8
228	95% Chebyshev UPL	721.3	99% Percentile	581.8
229	95% USL	634		
230				
231	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background			
232	data set free of outliers and consists of observations collected from clean unimpacted locations.			
233	The use of USL tends to provide a balance between false positives and false negatives provided the data			
234	represents a background data set and when many onsite observations need to be compared with the BTV.			
235				

Appendix B

ARARs Tables

TABLE B-1
CHEMICAL-SPECIFIC ARARs AND TBCs
DU 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3 FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-1: NO ACTION

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	CSFs are estimates of the upper-bound probability of an individual developing cancer as a result of a lifetime exposure to a particular concentration of a potential carcinogen.	This alternative would not prevent exposure to soil contaminants at DU 3-1, 3-2, and 3-3 which contribute to a calculated carcinogenic risk, developed using this guidance.
EPA Risk Reference Doses (RfDs)	None	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	This alternative would not prevent exposure to soil contaminants at DU 3-1, 3-2, and 3-3 which contribute to a calculated non-carcinogenic risk, developed using this guidance.
Guidelines for Carcinogenic Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	These guidelines provide guidance on conducting risk assessments involving carcinogens.	This alternative would not prevent exposure to soil contaminants at DU 3-1, 3-2, and 3-3 which contribute to a calculated carcinogenic risk, developed using this guidance.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F(March 2005)	To Be Considered	This provides guidance on assessing risk to children from carcinogens.	This alternative would not prevent exposure to soil contaminants at DU 3-1, 3-2, and 3-3 which contribute to a calculated carcinogenic risk to children, developed using this guidance.
EPA Guidance on Remedial Actions for Superfund Sites with PCB Contamination	EPA/540/G-90/007 (August 1990)	To Be Considered	This guidance provided preliminary remediation goals (PRGs) for PCBs for various media.	This alternative would not prevent exposure to PCB contamination in soil at DU 3-2 and DU 3-3 which exceeds the guidance value developed by EPA for PCBs in soil.
Recommendations of the Technical Review Workgroup for Lead for an approach to Assessing Risks Associated with Adult Exposure to Lead In Soil	EPA-540-R-03-001 (January 2003)	To Be Considered	EPA guidance for evaluating risks posed by lead in soil.	Used to calculate potential risks caused by exposure to lead in soil. This alternative would not prevent exposure to lead in soil at DU 3-3 which contributes to a calculated risk, developed using this guidance.
Recommended Toxicity Equivalence Factors (TEFs) for	EPA/600/R-10/005	To Be Considered	EPA guidance for evaluating risks posed by dioxin.	Used to calculate potential risks caused by exposure to dioxin in soil. This alternative would not prevent exposure to dioxin contamination in soil at DU 3-1 which

TABLE B-1
CHEMICAL-SPECIFIC ARARs AND TBCs
DU 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3 FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-1: NO ACTION

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds.				contributes to a calculated risk, developed using this guidance.
Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments	EPA/540/R-97/006	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs. This alternative would not prevent exposure to PCBs in soil at DU 3-3 which contribute to a calculated risk, developed using this guidance.
Final Guidelines for Ecological Risk Assessment	EPA/630/R095/002F	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs. This alternative would not prevent exposure to PCBs in soil at DU 3-3 which contribute to a calculated risk, developed using this guidance.
Guidance for Developing Ecological Soil Screening Levels	OSWER Directive 9285.7-55	To Be Considered	EPA guidance for generating ecological soil screening levels	Used to calculate potential wildlife risks and PRGs. This alternative would not prevent exposure to PCBs in soil at DU 3-3 which contribute to a calculated risk, developed using this guidance.
Toxicological Benchmarks for Wildlife: 1996 Revision	ES/ER/TM-86/R3	To Be Considered	Oak Ridge National Laboratory guidance on toxicity values for wildlife	Used to calculate potential wildlife risks and PRGs. This alternative would not prevent exposure to PCBs in soil at DU 3-3 which contribute to a calculated risk, developed using this guidance.
Wildlife Exposure Factors Handbook. Vols. I and II	EPA/600-R/R-93/187a	To Be Considered	EPA guidance on identifying exposure parameters for wildlife	Used to calculate potential wildlife risks and PRGs. This alternative would not prevent exposure to PCBs in soil at DU 3-3 which contribute to a calculated risk, developed using this guidance.
Development and Validation of Bioaccumulation Models for Earthworms	ES/ER/TM-220	To Be Considered	Oak Ridge National Laboratory guidance on uptake of contaminants from soil to earthworms	Used to calculate potential wildlife risks and PRGs. This alternative would not prevent exposure to PCBs in soil at DU 3-3 which contribute to a calculated risk, developed using this guidance.

TABLE B-1
CHEMICAL-SPECIFIC ARARs AND TBCs
DU 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3 FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-1: NO ACTION

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001, DEM-DSR-01-93, Section 8.02 (with the exception of 8.02A(iv)-TPH)	Applicable	These regulations set direct contact and leachability remediation standards for soil. These standards are applicable to a CERCLA remedy when they are more stringent than federal standards.	This alternative would not prevent exposure to any soil contaminants at DU 3-1, 3-2, and 3-3 that exceed State soil standards that are more stringent than federal risk-based standards.

Notes:
With no action, there are no location-specific or action-specific ARARs.

TABLE B-2a
CHEMICAL-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-2: LIMITED SOIL EXCAVATION WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	CSFs are estimates of the upper-bound probability of an individual developing cancer as a result of a lifetime exposure to a particular concentration of a potential carcinogen.	Used to compute the potential carcinogenic risks caused by exposure to contaminants in site media. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
EPA Risk Reference Doses (RfDs)	None	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants in side media. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
Guidelines for Carcinogenic Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	These guidelines provide guidance on conducting risk assessments involving carcinogens.	Used to calculate potential carcinogenic risks caused by exposure to contaminants in site media. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F(March 2005)	To Be Considered	This provides guidance on assessing risk to children from carcinogens.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants in site media. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
EPA Guidance on Remedial Actions for Superfund Sites with PCB Contamination	EPA/540/G-90/007 (August 1990)	To Be Considered	This guidance provided preliminary remediation goals (PRGs) for PCBs for various media.	Used in the development of the PRG for surface soil at DU 3-2 and 3-3 to be protective of unrestricted use by humans and ecological receptors. The action to be taken under this alternative will mitigate risk to receptors through excavation of soils in DU 3-3 that exceed the ecological PRG and instituting land use controls to restrict residential use at DU 3-1, 3-2, and 3-3 for areas exceeding the residential PRG.
Recommendations of the Technical Review Workgroup for Lead for an	EPA-540-R-03-001 (January 2003)	To Be Considered	EPA guidance for evaluating risks posed by lead in soil.	Used to calculate potential risks caused by exposure to lead in soil. The action to be taken under this alternative will mitigate risk to receptors through land use controls to restrict residential use at DU 3-1, 3-2,

TABLE B-2a
CHEMICAL-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-2: LIMITED SOIL EXCAVATION WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
approach to Assessing Risks Associated with Adult Exposure to Lead In Soil				and 3-3.
Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds.	EPA/600/R-10/005	To Be Considered	EPA guidance for evaluating risks posed by dioxin.	Used to calculate potential risks caused by exposure to dioxin in soil. The action to be taken under this alternative will mitigate risk to receptors through land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments	EPA/540/R-97/006	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the ecological PRG at DU 3-3.
Final Guidelines for Ecological Risk Assessment	EPA/630/R095/002F	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the ecological PRG at DU 3-3.
Guidance for Developing Ecological Soil Screening Levels	OSWER Directive 9285.7-55	To Be Considered	EPA guidance for generating ecological soil screening levels	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the ecological PRG at DU 3-3.
Toxicological Benchmarks for Wildlife: 1996 Revision	ES/ER/TM-86/R3	To Be Considered	Oak Ridge National Laboratory guidance on toxicity values for wildlife	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the ecological PRG at DU 3-3.
Wildlife Exposure Factors Handbook. Vols. I and II	EPA/600-R/R-93/187a	To Be Considered	EPA guidance on identifying exposure parameters for wildlife	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil that exceeds the ecological PRG at DU 3-3.
Development and Validation of Bioaccumulation	ES/ER/TM-220	To Be Considered	Oak Ridge National Laboratory guidance on uptake of contaminants from soil to earthworms	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through excavation of soil

TABLE B-2a
CHEMICAL-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-2: LIMITED SOIL EXCAVATION WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Models for Earthworms				that exceeds the ecological PRG at DU 3-3.
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001, DEM-DSR-01-93, Section 8.02 (with the exception of 8.02A(iv)-TPH)	Applicable	These regulations set direct contact and leachability remediation standards for soil. These standards are applicable to a CERCLA remedy when they are more stringent than federal standards.	Soil Direct Exposure Criteria (DEC) and Leachability Criteria were used in the development of PRGs for soil. The action to be taken under this alternative will meet the remediation regulations through excavation of soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.

TABLE B-2b
LOCATION-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-2: LIMITED SOIL EXCAVATION WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Coastal Zone Management Act	Coastal Zone Management Act, 16 USC 1451 *et. seq.*	Applicable	Requires that any actions must be conducted in a manner consistent with state-approved management programs.	A small portion of the site, including DU 3-1, appears to be located within a coastal zone management area. Under this alternative, soil actions are not anticipated within 200 feet of coastal features. However, applicable coastal zone management requirements will be met as needed during the remedial action.
Federal Endangered Species Act of 1973 (ESA); Endangered and Threatened Wildlife and Plants, Special Rules: Northern Long-Eared Bat	16 U.S.C. 1531 et seq.; 50 C.F.R § 17.40(o)	Applicable	The purpose of the ESA is to “conserve the ecosystems upon with threatened and endangered species depend” and to conserve and recover listed species. Federal agencies must consult with the U.S. Fish and Wildlife Service to ensure that the actions they authorize, fund, or carry out will not jeopardize listed species. The Northern Long-Eared Bat (NLEB) is listed as federally threatened. The NLEB range includes Coastal New England towns, such as Portsmouth, RI.	As part of pre-design investigations, Building 227 will be assessed to determine if it is potential bat overwintering habitat. If federally protected bats are located, the U.S. Fish and Wildlife Service will be consulted with during the planning process so that investigations and remedial actions do not adversely impact bat populations or habitat.
State				
Coastal Resources Management	RIGL 46-23-1 *et seq.*	Applicable	Sets standards for management and protection of coastal resources.	A small portion of the site, including DU 3-1, appears to be located within a coastal resource management area. Under this alternative, soil actions are not anticipated within 200 feet of coastal features. However, applicable coastal zone management requirements will be met as needed during the remedial action.

TABLE B-2c
ACTION-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-2: LIMITED SOIL EXCAVATION WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Clean Air Act (CAA), Hazardous Air Pollutants; National Emission Standards for Hazardous Air Pollutants (NESHAPS)	42 U.S.C. § 112(b)(1); 40 C.F.R. Part 61	Applicable	The regulations establish emissions standards for 189 hazardous air pollutants. Standards set for dust and other release sources.	If the excavation of contaminated soil at DU 3-2 and 3-3 generates regulated air pollutants, then measures will be implemented to meet these standards.
Toxic Substances Control Act (TSCA)	15 U.S.C. 2601 *et seq.*; PCB Remediation Waste 40 C.F.R 761.61(c)	Applicable	This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.	All soil exceeding identified Industrial and Ecological PRGs for PCBs at DU 3-3 will be excavated and disposed of off-site. The excavation, transportation, and management of PCB contaminated media will be performed in a manner to comply with TSCA, including air monitoring during remedial activities. Land use controls will prevent residential development in areas where PCB contaminated soil exceeds residential levels, will prevent exposure to inaccessible soil under the ECH building, and will establish requirements that any demolition of the ECH building will not cause any release of PCB-contaminated media The Navy will solicit public comment through the Proposed Plan on EPA's draft TSCA determination that the remedy's soil PCB cleanup levels, along with the excavation and management of the contaminated media will not pose an unreasonable risk to human health or the environment.
State				
RI Air Pollution Control Regulation No. 5: Fugitive Dust	RIGL 23-23 *et seq.*; CRIR 12-31-05	Applicable	Requires that reasonable measures be taken to prevent particulate matter from becoming airborne.	Remediation activities could potentially result in fugitive dust. Appropriate measures would need to be taken to prevent particulate matter from becoming airborne.
RI Air Pollution Control Regulation No. 7: Emissions of Air Detrimental to Persons or Property	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life, or cause damage to property, or which unreasonably interfere with the enjoyment of life and property.	Remediation activities may result in emissions. Appropriate measure would need to be taken to comply with these regulations.
Soil Erosion and Sediment Control Handbook, 1989	-	To Be Considered	Identifies soil erosion and sediment control (E & SC) requirements for construction activities involving land-disturbance activities.	E & SCs will be used during soil disturbance activities, such as excavation.
Standards for Identification and	RIGL 23-9.1 *et seq.*; Code of Rhode	Applicable	Requires a determination be made as to whether waste meets the definition of	These regulations apply to all waste generated during actions at the site, such as excavated soil, and will be

TABLE B-2c
ACTION-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-2: LIMITED SOIL EXCAVATION WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Listing of Hazardous Waste; RI Rules and Regulations for Hazardous Waste Management, Hazardous Waste Determination	Island Rules (CRIR) 12-030-003 Rule 5.3		hazardous waste.	used when determining whether or not a solid waste is hazardous. The soil at both DU 3-2 and 3-3 is not expected to be hazardous.
Standards for Generators of Hazardous Waste; Rules and Regulations for Hazardous Waste Management, Generator Standards	RIGL 23-9.1 *et seq.*; Code of Rhode Island Rules (CRIR) 12-030-003, Rule 5.3, 5.9, 5.12, 5.13	Applicable	Establishes accumulation, manifesting, and pre-transport of requirements for hazardous waste.	These regulations would apply to any waste generated at the site that is determined to be hazardous, such as excavated soil. The soil at both DU 3-2 and 3-3 is not expected to be hazardous.

TABLE B-3a
CHEMICAL-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-3: CONTAINMENT WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Human Health Assessment Cancer Slope Factors (CSFs)	None	To Be Considered	CSFs are estimates of the upper-bound probability of an individual developing cancer as a result of a lifetime exposure to a particular concentration of a potential carcinogen.	Used to compute the potential carcinogenic risks caused by exposure to contaminants in site media. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
EPA Risk Reference Doses (RfDs)	None	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants in side media. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
Guidelines for Carcinogenic Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	These guidelines provide guidance on conducting risk assessments involving carcinogens.	Used to calculate potential carcinogenic risks caused by exposure to contaminants in site media. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F(March 2005)	To Be Considered	This provides guidance on assessing risk to children from carcinogens.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants in site media. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the PRGs for industrial use at DU 3-2 and 3-3 and land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
EPA Guidance on Remedial Actions for Superfund Sites with PCB Contamination	EPA/540/G-90/007 (August 1990)	To Be Considered	This guidance provided preliminary remediation goals (PRGs) for PCBs for various media.	Used in the development of the PRG for surface soil at DU 3-2 and 3-3 to be protective of unrestricted use by humans and ecological receptors. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soils in DU 3-3 that exceed the ecological PRG and instituting land use controls to restrict residential use at DU 3-1, 3-2, and 3-3 for areas exceeding the residential PRG.
Recommendations of the Technical Review Workgroup for Lead for an	EPA-540-R-03-001 (January 2003)	To Be Considered	EPA guidance for evaluating risks posed by lead in soil.	Used to compute the potential risks caused by exposure to lead in site soil. The action to be taken under this alternative will mitigate risk to receptors through land use controls to restrict residential use at DU 3-1, 3-2,

TABLE B-3a
CHEMICAL-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-3: CONTAINMENT WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
approach to Assessing Risks Associated with Adult Exposure to Lead In Soil				and 3-3.
Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds.	EPA/600/R-10/005	To Be Considered	EPA guidance for evaluating risks posed by dioxin.	Used in the development of the dioxin PRG for soil to be protective of unrestricted use by humans. The action to be taken under this alternative will mitigate risk to receptors through land use controls to restrict residential use at DU 3-1, 3-2, and 3-3.
Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments	EPA/540/R-97/006	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the ecological PRG at DU 3-3.
Final Guidelines for Ecological Risk Assessment	EPA/630/R095/002F	To Be Considered	EPA guidance for conducting ecological risk assessments	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the ecological PRG at DU 3-3.
Guidance for Developing Ecological Soil Screening Levels	OSWER Directive 9285.7-55	To Be Considered	EPA guidance for generating ecological soil screening levels	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the ecological PRG at DU 3-3.
Toxicological Benchmarks for Wildlife: 1996 Revision	ES/ER/TM-86/R3	To Be Considered	Oak Ridge National Laboratory guidance on toxicity values for wildlife	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the ecological PRG at DU 3-3.
Wildlife Exposure Factors Handbook. Vols. I and II	EPA/600-R/R-93/187a	To Be Considered	EPA guidance on identifying exposure parameters for wildlife	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover over soil that exceeds the ecological PRG at DU 3-3.
Development and Validation of Bioaccumulation	ES/ER/TM-220	To Be Considered	Oak Ridge National Laboratory guidance on uptake of contaminants from soil to earthworms	Used to calculate potential wildlife risks and PRGs. The action to be taken under this alternative will mitigate risk to receptors through installation of an asphalt cover

TABLE B-3a
CHEMICAL-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-3: CONTAINMENT WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Models for Earthworms				over soil that exceeds the ecological PRG at DU 3-3.
State				
State of Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases (Short Title: Remediation Regulations)	Code of Rhode Island Rules (CRIR) 12-180-001, DEM-DSR-01-93, Section 8.02 (with the exception of 8.02A(iv)-TPH)	Applicable	These regulations set direct contact and leachability remediation standards for soil. These standards are applicable to a CERCLA remedy when they are more stringent than federal standards.	Soil Direct Exposure Criteria and Leachability Criteria were used in the development of PRGs for soil. The action to be taken under this alternative for soil at DU 3-2 and 3-3 will meet the remediation regulations through placement of an asphalt cover over the full extent of soil that exceeds PRGs for industrial use (including RIDEM GA Leachability Criteria), and implementation of land use controls to prevent residential use and ensure that the asphalt cover remains intact and minimizes the leaching of PAHs and PCBs from soil to groundwater.

TABLE B-3b
LOCATION-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-3: CONTAINMENT WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Coastal Zone Management Act	Coastal Zone Management Act, 16 USC 1451 *et. seq.*	Applicable	Requires that any actions must be conducted in a manner consistent with state-approved management programs.	A small portion of the site, including DU 3-1, appears to be located within a coastal zone management area. Under this alternative, soil actions are not anticipated within 200 feet of coastal features. However, applicable coastal zone management requirements will be met as needed during the remedial action.
Federal Endangered Species Act of 1973 (ESA); Endangered and Threatened Wildlife and Plants, Special Rules: Northern Long-Eared Bat	16 U.S.C. 1531 et seq.; 50 C.F.R § 17.40(o)	Applicable	The purpose of the ESA is to "conserve the ecosystems upon with threatened and endangered species depend" and to conserve and recover listed species. Federal agencies must consult with the U.S. Fish and Wildlife Service to ensure that the actions they authorize, fund, or carry out will not jeopardize listed species. The Northern Long-Eared Bat (NLEB) is listed as federally threatened. The NLEB range includes Coastal New England towns, such as Portsmouth, RI.	As part of pre-design investigations, Building 227 will be assessed to determine if it is potential bat overwintering habitat. If federally protected bats are located, the U.S. Fish and Wildlife Service will be consulted with during the planning process so that investigations and remedial actions do not adversely impact bat populations or habitat.
State				
Coastal Resources Management	RIGL 46-23-1 *et seq.*	Applicable	Sets standards for management and protection of coastal resources.	A small portion of the site, including DU 3-1, appears to be located within a coastal resource management area. Under this alternative, soil actions are not anticipated within 200 feet of coastal features. However, applicable coastal zone management requirements will be met as needed during the remedial action.

TABLE B-3c
ACTION-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-3: CONTAINMENT WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Federal				
Clean Air Act (CAA), Hazardous Air Pollutants; National Emission Standards for Hazardous Air Pollutants (NESHAPS)	42 U.S.C. § 112(b)(1); 40 C.F.R. Part 61	Applicable	The regulations establish emissions standards for 189 hazardous air pollutants. Standards set for dust and other release sources.	If the installation and maintenance of the cover DU 3-2 and 3-3 generates regulated air pollutants, then measures will be implemented to meet these standards.
Toxic Substances Control Act (TSCA)	15 U.S.C. 2601 *et seq.*; PCB Remediation Waste 40 C.F.R 761.61(c)	Applicable	This section of the TSCA regulations provides risk-based cleanup and disposal options for PCB remediation waste based on the risks posed by the concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.	An asphalt cover will be placed over all soil exceeding identified Industrial and Ecological PRGs for PCBs at DU 3-3. Management of PCB contaminated media is not anticipated. Land use controls will prevent residential development in areas where PCB contaminated soil exceeds residential levels, will protect the asphalt cover, will prevent exposure to inaccessible soil under the ECH building, and will establish requirements that any demolition of the ECH building will not cause any release of PCB-contaminated media The Navy will solicit public comment through the Proposed Plan on EPA's draft TSCA determination that the remedy's soil PCB cleanup levels, along with the installation of an asphalt cover will not pose an unreasonable risk to human health or the environment.
State				
RI Air Pollution Control Regulation No. 5: Fugitive Dust	RIGL 23-23 *et seq.*; CRIR 12-31-05	Applicable	Requires that reasonable measures be taken to prevent particulate matter from becoming airborne.	Remediation activities could potentially result in fugitive dust. Appropriate measures would need to be taken to prevent particulate matter from becoming airborne.
RI Air Pollution Control Regulation No. 7: Emissions of Air Detrimental to Persons or Property	RIGL 23-23 *et seq.*; CRIR 12-31-07	Applicable	Prohibits emissions of contaminants which may be injurious to humans, plant or animal life, or cause damage to property, or which unreasonably interfere with the enjoyment of life and property.	Remediation activities may result in emissions. Appropriate measure would need to be taken to comply with these regulations.
Soil Erosion and Sediment Control Handbook, 1989	-	To Be Considered	Identifies soil erosion and sediment control (E & SC) requirements for construction activities involving land-disturbance activities.	E & SCs will be used during the installation of the asphalt cover.
Standards for Identification and Listing of Hazardous Waste; RI Rules and Regulations for	RIGL 23-9.1 *et seq.*; Code of Rhode Island Rules (CRIR) 12-030-003 Rule 5.3	Applicable	Requires a determination be made as to whether waste meets the definition of hazardous waste.	These regulations apply to all waste generated during actions at the site and will be used when determining whether or not a solid waste is hazardous. Hazardous waste is not anticipated at the Site.

TABLE B-3c
ACTION-SPECIFIC ARARs AND TBCs
DECISION UNIT 3-1, 3-2, AND 3-3 AT SITE 11 – TANK FARM 3, FEASIBILITY STUDY
NAVSTA NEWPORT, PORTSMOUTH, RHODE ISLAND
ALTERNATIVE S-3: CONTAINMENT WITH LAND USE CONTROLS

Requirement	Citation	Status	Requirement Synopsis	Action to Be Taken to Attain Requirement
Hazardous Waste Management, Hazardous Waste Determination				
Standards for Generators of Hazardous Waste; Rules and Regulations for Hazardous Waste Management, Generator Standards	RIGL 23-9.1 *et seq.*; Code of Rhode Island Rules (CRIR) 12-030-003, Rule 5.3, 5.9, 5.12, and 5.13	Applicable	Establishes accumulation, manifesting, and pre-transport of requirements for hazardous waste.	These regulations apply to all waste generated during actions at the site and will be used when determining whether or not a solid waste is hazardous. Hazardous waste is not anticipated at the Site.
Rhode Island Solid Waste Regulations – Dust Control	DEM OWMSW0401, 1.7.10	Relevant and Appropriate	Requires dust control.	Dust will be controlled at the site during cover construction and during maintenance activities.
Rhode Island Solid Waste Regulations – Sedimentation and Erosion Control	DEM OWMSW0401, 2.1.04	Relevant and Appropriate	Requires development of a "Sedimentation and Erosion Control Plan."	Sedimentation and erosion controls will be implemented during installation of the asphalt cover.
Rhode Island Solid Waste Regulations – Cover Permeability	DEM OWM-SW0401, 2.3.04(e), (f)	Relevant and Appropriate	Outlines the requirements for the maintenance and permeability of cover material.	The substantive requirements of this section of the regulations will be met by maintaining an asphalt cover that has been determined to provide an adequate barrier for the contaminants remaining in the soil.
Rhode Island Solid Waste Regulations – Surface Water Drainage	DEM OWM-SW-0401, 2.3.10	Relevant and Appropriate	Contains requirements for surface water drainage.	The substantive requirements of this section of the regulations will be met through design of appropriate surface drainage considerations for the cover. The cover system would be designed to prevent erosion, sedimentation, and standing water on the cover.

Appendix C

Cost Estimates

Planning Cost Estimate Summary

Alternative:	S-1 No Action		
Site:	DU 3-1, 3-2, and 3-3 at Site 11 - Tank Farm 3, NAVSTA Newport	Description:	This alternative consists of no remedial action as a baseline comparison.
Location:	Portsmouth, Rhode Island		
Phase:	FS		
Date:	September 2015		

PERIODIC COSTS

Description	QTY	UNIT	UNIT COST	Total	Notes
No costs are estimated for this No Action alternative.					
SUBTOTAL				$0	
TOTAL PERIODIC ANNUAL COSTS				$0	

PRESENT VALUE ANALYSIS

Cost Type	Total Cost per Year	Discount Factor	Present Value	Notes
Capital Cost	0		$0	
O&M Cost	0		$0	
Periodic Cost	$0		$0	
Total Present Value of Alternative			$0	

Planning Cost Estimate Summary

Alternative:	S-2 Limited Soil Excavation with Land Use Controls		
Site:	DU 3-1, 3-2, and 3-3 at Site 11 - Tank Farm 3, NAVSTA Newport	Description:	Under this alternative, limited soil excavation and off-site disposal would be performed at DU 3-2 and 3-3 to remove soils exceeding the Industrial PRGs (including RIDEM GA Leachability Criteria) and Ecological PRGs (applicable to DU 3-3 only). LUCs would also be implemented at DU 3-1, 3-2, and 3-3 is to prevent residential use of the property.
Location:	Portsmouth, Rhode Island		
Phase:	FS		
Date:	September 2015		

CAPITAL COSTS

Description		QTY	UNIT	UNIT COST	Total	Notes
Land Use Control Remedial Design (LUC RD)						
Prepare LUC RD (4 iterations)		1	LS	$15,000	$15,000	Estimated
					$15,000	
Delineation Soil Sampling						
HASP		1	LS	$7,000	$7,000	
Work Plan/UFP SAP		1	LS	$30,000	$30,000	
Direct push drill rig and operator		8	day	$2,000	$16,000	Assumes 61 soil borings with average depth to 5 ft
Labor to record and collect samples		16	person-days	$1,500	$24,000	Assume 12-hr field day
Laboratory analyses:						
	PAHs	147	EA	$120	$17,640	See Backup for sampling and analysis assumptions. Quantities include field duplicates.
	Lead	10	EA	$20	$200	
	Manganese	90	EA	$20	$1,800	
	Arsenic	10	EA	$20	$200	
	Total Chromium	11	EA	$20	$220	
	Hexavalent Chromium	11	EA	$65	$715	
	Dioxins	93	EA	$450	$41,850	
	PCBs	35	EA	$60	$2,100	
	VOCs	3	EA	$80	$240	
	TAL Metals	3	EA	$100	$300	
	Petroleum Hydrocarbons	3	EA	$50	$150	
Travel		16	person-days	$200	$3,200	
Field supplies and equipment		1	EA	$1,500	$1,500	Allowance
Data Validation		50	HR	$100	$5,000	Allowance
Surveying		1	LS	$2,000	$2,000	Sample locations, contours, surface features
Tech Memo (2 iterations)		60	HR	$100	$6,000	Allowance
					$160,115	
Site Preparation and Management						
RA Contractor Work Plan		1	LS	$20,000	$20,000	
HASP		1	LS	$7,000	$7,000	
Equipment mobilization		1	LS	$2,500	$2,500	
Temporary facilities		1	LS	$500	$500	
Erosion control measures		100	LF	$4	$400	
Clearing and grubbing		325	SF	$8	$2,600	
					$33,000	
Excavation						
Excavate soil		60	CY	$15	$900	Based on 5 foot depth and areas shown on Figures 12 and 15
Dust control and air monitoring		1	LS	$500	$500	
Clean fill testing		1	EA	$830	$830	Estimate for VOCs, SVOCs, PCBs, pesticides, TPH, metals
Furnish common fill		72	CY	$15	$1,080	Cost to backfill excavation footprint
Install clean fill		72	CY	$15	$1,080	
Regrade excavation footprint		325	SF	$1	$325	
Seeding		325	SF	$5	$1,625	
					$6,340	
Soil Disposal						
Waste Characterization		1	EA	$830	$830	Estimate for VOCs, SVOCs, PCBs, pesticides, TPH, metals; 1 per 500 CY
T&D non-haz soil		90	Ton	$75	$6,750	
					$7,580	
Post-Construction						
Contractor Completion Report		75	HR	$100	$7,500	
Remedial Action Completion Report (2 iterations)		150	HR	$100	$15,000	
					$22,500	
SUBTOTAL					$244,535	
Contingency	30%				$73,361	Scope (15%)+ Bid(15%)
SUBTOTAL					$317,896	

Planning Cost Estimate Summary

Alternative: S-2 Limited Soil Excavation with Land Use Controls

Project Management	6%				$19,073.73	
Remedial Design	4%				$12,715.82	
Construction Management	6%				$19,073.73	
TOTAL CAPITAL COSTS					$368,759	

O&M COSTS

Description		QTY	UNIT	UNIT COST	Total	Notes
Annual LUC Site inspections (through year 30)		1	each	$3,500	$3,500	Estimated; See attached worksheet
SUBTOTAL					$3,500	
Contingency	0%				$0	
Project Management	10%				$350	
TOTAL O&M ANNUAL COSTS					$3,850	

PERIODIC COSTS

Description	QTY	UNIT	UNIT COST	Total	Notes
Five Year Review (through year 30)	6	each	$5,000	$30,000	Assume one component of base-wide 5-yr review
SUBTOTAL				$30,000	
TOTAL PERIODIC ANNUAL COSTS				$5,000	

PRESENT VALUE ANALYSIS

Cost Type	Year	Total Cost	Total Cost per Year	Discount Factor at 1.5%	Present Value	Notes
Capital Cost	0	$368,759	$368,759	1	$368,759	Discount rate of 1.5% is based on the
O&M Cost	1 to 30	$115,500	$3,850	24.0158	$92,461	30-Year Real Interest Rate in Appendix C
Periodic Cost	5	$5,000	$5,000	0.9283	$4,642	of the White House Office of Management
	10	$5,000	$5,000	0.8617	$4,309	and Budget (OMB) Circular A-94, Revised
	15	$5,000	$5,000	0.7999	$4,000	December 2014.
	20	$5,000	$5,000	0.7425	$3,713	
	25	$5,000	$5,000	0.6892	$3,446	
	30	$5,000	$5,000	0.6398	$3,199	
Total Present Value of Alternative					$484,527	

Planning Cost Estimate Summary

Alternative:	S-3 Containment with Land Use Controls
Site:	DU 3-1, 3-2, and 3-3 at Site 11 - Tank Farm 3, NAVSTA Newport
Location:	Portsmouth, Rhode Island
Phase:	FS
Date:	September 2015

Description: Under this alternative, an impermeable cap would be placed over soil in excess of the Industrial PRGs (including RIDEM GA Leachability Criterion) at DU 3-2 and 3-3. The cap would also cover soils exceeding the Ecological PRG at DU 3-3. LUCs would be applied to the DU 3-2 and 3-3 that restrict cover disturbance and require maintenance of the impermeable caps as well as perform associated inspections, groundwater monitoring, and reporting. LUCs would also be applied to DU 3-1, 3-2, and 3-3 that prevent residential and unrestricted recreational use.

CAPITAL COSTS

Description		QTY	UNIT	UNIT COST	Total	Notes
Land Use Control Remedial Design (LUC RD)						
Prepare LUC RD (4 iterations)		1	LS	$15,000	$15,000	Estimated
					$15,000	
Delineation Soil Sampling						
HASP		1	LS	$7,000	$7,000	
Work Plan/UFP SAP		1	LS	$30,000	$30,000	
Direct push drill rig and operator		8	day	$2,000	$16,000	Assumes 61 soil borings with average depth to 5 ft
Labor to record and collect samples		16	person-days	$1,500	$24,000	Assume 12-hr field day
Laboratory analyses:						
PAHs		147	EA	$120	$17,640	See Backup for sampling and analysis assumptions. Quantities include field duplicates.
Lead		10	EA	$20	$200	
Manganese		90	EA	$20	$1,800	
Arsenic		10	EA	$20	$200	
Total Chromium		11	EA	$20	$220	
Hexavalent Chromium		11	EA	$65	$715	
Dioxins		93	EA	$450	$41,850	
PCBs		35	EA	$60	$2,100	
VOCs		3	EA	$80	$240	
TAL Metals		3	EA	$100	$300	
Petroleum Hydrocarbons		3	EA	$50	$150	
Travel		16	person-days	$200	$3,200	
Field supplies and equipment		1	EA	$1,500	$1,500	Allowance
Data Validation		50	HR	$100	$5,000	Allowance
Surveying		1	LS	$2,000	$2,000	Sample locations, contours, surface features
Tech Memo (2 iterations)		60	HR	$100	$6,000	Allowance
					$160,115	
Site Preparation and Management						
RA Work Plan		1	LS	$20,000	$20,000	
HASP		1	LS	$7,000	$7,000	
Equipment mobilization		1	LS	$5,000	$5,000	
Temporary facilities		1	LS	$2,500	$2,500	
Erosion control measures		100	LF	$4	$400	
Clearing and grubbing		325	SF	$8	$2,600	
					$37,500	
Construct Impermeable Cover						
Dust control and air monitoring		1	LS	$1,000	$1,000	
Regrade cap area		325	SF	$1	$325	
Clean fill testing		1	EA	$830	$830	Estimate for VOCs, SVOCs, PCBs, pesticides, TPH, metals
Furnish sub-base material		8	CY	$15	$120	A minimum of 6 inches of clean sub-base material will be installed prior to installation of asphalt pavement
Install sub-base material		8	CY	$15	$120	
Install asphalt pavement		4	CY	$375	$1,500	Cost to have asphalt to be poured 4" over 300 SF
Survey to document final cover elevations		1	LS	$2,000	$2,000	
					$5,895	
Post-Construction						
Contractor Completion Report		75	HR	$100	$7,500	
Remedial Action Completion Report (2 iterations)		150	HR	$100	$15,000	
					$22,500	
SUBTOTAL					$241,010	
Contingency	30%				$72,303	Scope (15%)+ Bid(15%)
SUBTOTAL					$313,313	
Project Management	6%				$18,798.78	
Remedial Design	6%				$18,798.78	
Construction Management	6%				$18,798.78	
TOTAL CAPITAL COSTS					$369,709	

Planning Cost Estimate Summary

Alternative: S-3 Containment with Land Use Controls

O&M COSTS

Description		QTY	UNIT	UNIT COST	Total	Notes
Allowance for maintenance		1	each	$500	$500	Allowance for misc. needs
Annual LUC Site inspections (through year 30)		1	each	$3,500	$3,500	Estimated; See attached worksheet
SUBTOTAL					$4,000	
Contingency	0%				$0	
Project Management	10%				$400	
TOTAL O&M ANNUAL COSTS					$4,400	

PERIODIC COSTS

Description	QTY	UNIT	UNIT COST	Total	Notes
Five Year Review (through year 30)	6	each	$5,000	$30,000	Assume one component of base-wide 5-yr review
SUBTOTAL				$30,000	
TOTAL PERIODIC ANNUAL COSTS				$5,000	

PRESENT VALUE ANALYSIS

Cost Type	Year	Total Cost	Total Cost per Year	Discount Factor at 1.5%	Present Value	Notes
Capital Cost	0	$369,709	$369,709	1	$369,709	Discount rate of 1.5% is based on the
O&M Cost	1 to 30	$132,000	$4,400	24.0158	$105,670	30-Year Real Interest Rate in Appendix C
Periodic Cost	5	$5,000	$5,000	0.9283	$4,642	of the White House Office of Management
	10	$5,000	$5,000	0.8617	$4,309	and Budget (OMB) Circular A-94, Revised
	15	$5,000	$5,000	0.7999	$4,000	December 2014.
	20	$5,000	$5,000	0.7425	$3,713	
	25	$5,000	$5,000	0.6892	$3,446	
	30	$5,000	$5,000	0.6398	$3,199	
Total Present Value of Alternative					$498,686	

Planning Cost Backup Worksheet

Alternative: S-2 Limited Soil Excavation with Land Use Controls

Site: DU 3-1, 3-2, and 3-3 at Site 11 - Tank Farm 3, NAVSTA Newport
Location: Portsmouth, Rhode Island
Phase: FS
Date: September 2015

Assumptions:

DU 3-1 Soil Sampling (not including QA/QC)
Sampling and analysis to delineate contamination and assess whether hexavalent chromium is present above the PRG or if it should be eliminated as a COC
- Assume resampling of 5 previous locations TF3-001-SS102, TF3-001-SS106, TF3-001-SS107, TF3-001-SS108, and TF3-001-SS109 that had total chromium in excess of the PRG for total and hexavalent chromium.
- Assume 30 surface soil samples and 45 subsurface soil samples will be collected and analyzed for dioxins, PAHs, and manganese.
- Assume 10 soil samples will be collected and analyzed for arsenic.
- Assume resampling of the two SIRAR subsurface soil locations with elevated TPH. Samples wil be analyzed for VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO)

DU 3-2 Delineation Soil Sampling (not including QA/QC)
Sampling and analysis to delineate overall extent of PCBs and PAHs
- Assume 6 surface soil samples and 3 subsurface soil samples will be collected and analyzed for PCBs.
- Assume 15 surface soil samples and 30 subsurface soil samples (2 depth intervals) will be collected and analyzed for PAHs.

DU 3-3 Delineation Soil Sampling (not including QA/QC)
Sampling and analysis to delineate overall extent of PCBs and lead
- Assume 8 surface soil samples and 12 subsurface soil samples will be collected and analyzed for PCBs
- Assume 4 surface soil samples and 4 subsurface soil samples will be collected and analyzed for lead
- Assume resampling of 4 previous locations that had highest concentrations total chromium in excess of the PRG for total and hexavalent chromium.

Work Statement:
Annual Land Use Control (LUC) Inspections and Reporting

Description	QTY	UNIT	UNIT COST	Total	Notes
Travel	1	LS	$200	$200	
Labor for Inspection	24	HR	$100	$2,400	
Report	8	HR	$100	$800	
Misc	1	LS	$100	$100	
TOTAL COST PER ANNUAL INSPECTION				$3,500	

Source of Cost Data:
Engineering Estimate

Cost Adjustment Factor:

FACTOR:		NOTES:
H&S Productivity (labor & equip)		Level D
Escalation to Base Year		
Area Cost Factor		
Subcontractor Overhead & Prof.		
Prime Contractor Overhead & Prof.		

Planning Cost Backup Worksheet

Alternative:	S-3 Containment with Land Use Controls
Site:	DU 3-1, 3-2, and 3-3 at Site 11 - Tank Farm 3, NAVSTA Newport
Location:	Portsmouth, Rhode Island
Phase:	FS
Date:	September 2015

Assumptions:

DU 3-1 Soil Sampling (not including QA/QC)

Sampling and analysis to delineate contamination and assess whether hexavalent chromium is present above the PRG or if it should be eliminated as a COC

Assume resampling of 5 previous locations TF3-001-SS102, TF3-001-SS106, TF3-001-SS107, TF3-001-SS108, and TF3-001-SS109 that had total chromium in excess of the PRG for total and hexavalent chromium.

Assume 30 surface soil samples and 45 subsurface soil samples wil be collected and analyzed for dioxins, PAHs, and manganese.

Assume 10 soil samples wil be collected and analyzed for arsenic.

Assume resampling of the two SIRAR subsurface soil locations with elevated TPH. Samples wil be analyzed for VOCs, PAHs, dioxin/furans, metals, and petroleum hydrocarbons (ExTPH/GRO)

DU 3-2 Delineation Soil Sampling (not including QA/QC)

Sampling and analysis to delineate overall extent of PCBs and PAHs

Assume 6 surface soil samples and 3 subsurface soil samples will be collected and analyzed for PCBs.

Assume 15 surface soil samples and 30 subsurface soil samples (2 depth intervals) will be collected and analyzed for PAHs.

DU 3-3 Delineation Soil Sampling (not including QA/QC)

Sampling and analysis to delineate overall extent of PCBs and lead

Assume 8 surface soil samples and 12 subsurface soil samples will be collected and analyzed for PCBs

Assume 4 surface soil samples and 4 subsurface soil samples will be collected and analyzed for lead

Assume resampling of 4 previous locations that had highest concentrations total chromium in excess of the PRG for total and hexavalent chromium.

Work Statement:

Annual Land Use Control (LUC) Inspections and Reporting

Description	QTY	UNIT	UNIT COST	Total	Notes
Travel	1	LS	$200	$200	
Labor for Inspection	24	HR	$100	$2,400	
Report	8	HR	$100	$800	
Misc	1	LS	$150	$100	
TOTAL COST PER ANNUAL INSPECTION				$3,500	

Source of Cost Data:

Engineering Estimate

Cost Adjustment Factor:

FACTOR:		NOTES:
H&S Productivity (labor & equip)		Level D
Escalation to Base Year		
Area Cost Factor		
Subcontractor Overhead & Prof.		
Prime Contractor Overhead & Prof.		